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THE WISTAR INSTITUTE OF ANATOMY AND BIOLOGY AND ITS ADVISORY BOARD[1]

WE have assembled to-day to celebrate the twentieth anniversary of the organization of the advisory board of The Wistar Institute. It devolves upon me to tell you something of the history of The Wistar Institute and of the origin and purpose of its advisory board.

In a sense, this celebration is a family affair, of our board of managers, our local staff, our advisory board and our journal editors, to which have been invited a few colleagues from other laboratories and a few prominent citizens of Philadelphia who are interested in local institutions. Thus we meet as a social group brought together by a common interest and actuated by a sentiment which has grown with twenty years of effort in our field of science.

In a broader sense, this celebration is not especially to show what The Wistar Institute has accomplished, but rather to record the achievements of a method of procedure. Concentrated and coordinated efforts according to a program, might be our slogan.

To the lay citizens who honor us by their presence, we express our appreciation of the privilege of demonstrating what may be accomplished in biological science by cooperative activity.

To the University of Pennsylvania, under the leadership of Dr. William Pepper, a provost of prophetic vision, is due the credit for having organized the first biological research institute in this country.

General Isaac J. Wistar, by his princely gift to anatomical science, made it possible for the university to incorporate this institute under a charter from the Commonwealth of Pennsylvania on an independent foundation and set it apart from other activities of the university in the pursuit of new and original knowledge.

With an appreciation of the results which may be accomplished by independent initiative, the university and General Wistar agreed that the relations which should exist between the mother institution and its offspring should be those of close cooperation while maintaining strict organic independence. This was accomplished by a law requiring the university to choose six of its board of nine managers, while the

[1] Read at the celebration of the twentieth anniversary of the advisory board of The Wistar Institute, April 13, 1925.

other three are fixed by General Wistar's deeds of trust.

If this celebration should direct the attention of some philanthropic person to the advantages of endowed research institutes, it will have served a double purpose. (For there are other fields of university work equally deserving of independent foundations where research may be pursued without the interruptions incident to undergraduate teaching.)

Let us, for a moment, see what were the circumstances which led to the foundation of this institute.

As early as 1750, private schools of anatomy were opened in Philadelphia. (Dr. Thomas Cadwalader.)

In 1762, Dr. William Shippen began teaching anatomy in his private school in Philadelphia, and, as is well known to Pennsylvania medical men, he and Dr. John Morgan organized the school of medicine of the Pennsylvania College, now the University of Pennsylvania, in 1765.

Shippen and Morgan had both been students of the celebrated English anatomist, John Hunter, and closely associated with him in his surgical practice as well as his anatomical work.

Shippen was chosen as professor of anatomy and surgery in the new medical school. In 1792, Shippen accepted, as his adjunct professor of anatomy, Dr. Caspar Wistar, then a young man of thirty years, who had taken his degree of doctor of medicine in Edinburgh and had availed himself of the opportunities offered by the celebrated teachers of anatomy both in Edinburgh and London.

Wistar's anatomical interests were not alone of the practical kind, for he had devoted much time to the study of comparative anatomy, and was elected to the presidency of the Edinburgh "Society for the Further Investigation of Natural History." He was also honored by election to the presidency of the "Royal Medical Society of Edinburgh."

In 1808, following the death of Dr. William Shippen, Wistar was elected to the professorship of anatomy in the University of Pennsylvania. His desire to perfect his anatomical demonstrations, while adjunct professor, had led him to a keen appreciation of John Hunter's methods, and gradually, during the ten years which followed, he accumulated a most complete series of dissections and preparations useful in the teaching of anatomy. (Many of these preparations may be seen in the institute to-day.)

Wistar continued as professor of anatomy till his death in 1818, during which time he made important anatomical discoveries and wrote the first American text-book of human anatomy—an excellent work which passed through several editions.

The teaching museum which Wistar prepared was presented by his widow to the University of Pennsylvania.

Through the labors and generosity of succeeding incumbents of the chair of anatomy—Physick, Horner and Leidy—this museum was considerably increased in extent and value and was known as the Wistar or Wistar and Horner Museum.

The science of anatomy in America from the time of Shippen to that of Leidy had made but little advancement. In most medical schools the chair of anatomy was the stepping-stone to that of surgery. Not so, however, in the case of the chair of anatomy at the University of Pennsylvania, where it had become conspicuous by reason of the eminence of its incumbents.

Along with the great teacher and investigator, Leidy, came Cope, Harrison Allen and Ryder—all engaged in researches in comparative anatomy here at the University of Pennsylvania.

Leidy used the preparations of the Wistar Museum for demonstrations in his lectures to medical students. Gradually the older preparations had become damaged from use and dust. There was need of attention in the museum. Specimens were to be cleaned and mounted.

It was at this stage that the dean of the Medical School, Dr. James Tyson, approached General Isaac J. Wistar, a grand-nephew of Professor Caspar Wistar, for financial assistance to maintain the Wistar Museum.

On July 20, 1891, a trust was created by General Wistar with a fund of approximately $20,000, the income of which was to be used for the care of the Wistar Museum.

General Wistar, whose father was a physician, had always been interested in natural history. This inclination had led him to take active part in the affairs of the Academy of Natural Sciences, of which he was president from 1891 to 1895.

Having vested $20,000 in a trust for the care of the Wistar Museum, his interest was increased, and largely through the influence of Provost Pepper and because the museum bore his family name he determined to do something further for it. Accordingly, in less than a year from the date of the foundation of the original trust, The Wistar Institute of Anatomy and Biology was incorporated (March 8, 1892) and endowed by General Wistar.

The University of Pennsylvania, whose officers had conceived the idea of a new institution for anatomical research, transferred to the newly created Wistar Institute of Anatomy ground for a building and presented the original Wistar Museum.

A museum and laboratory building was erected by General Wistar; the Wistar Museum was transferred from the medical school to the new building, and on May 21, 1894, The Wistar Institute was formally opened.

General Wistar had been impressed by the desirability of a special institute devoted to the promotion of the biological sciences underlying the art of medicine. He had been influenced by Harrison Allen as to the requirements of such an institute, and by John A. Ryder, who had advocated an elaborate synthetic museum of comparative anatomy where, by properly prepared and labeled specimens presenting the developmental stages in each of a series of types selected from the several classes of animals, the student might observe nature's own record of the evolution of organic forms, including man.

Ryder's synthetic anatomical museum was a great conception: no one could doubt its value as a means of demonstrating biological processes or as reference material in morphological research where, instead of depending upon the observations and interpretations of others, reference could readily be made to structures as nature presents them.

If there were criticisms of this method of fostering anatomical research, they were little emphasized at the time. But with the march of years the methods of biological research have been extended and a vast deal of new knowledge, both anatomical and physiological, has been acquired by experimental procedures with living animals. The synthetic museum would be of far less service in most of the present-day experimental research.

While General Wistar was impressed with the advantages of a great anatomical museum as a means of advancing anatomical science, his long experience with men and their various undertakings had left a wisdom of an unusual sort. He knew well that the methods of to-day may not be those of to-morrow, even in research. And so, in the charter of this institute and in General Wistar's trust deeds, the purposes of the institute are defined as follows:

First, the preservation and free exhibition of the Wistar Museum.

Second, extension of the museum to include all objects and preparations useful in advanced biological studies and that bear upon the physical development of man.

Third, the establishment of a system of lectures on biological subjects for postgraduates or advanced students only. All undergraduate teaching is prohibited.

Fourth, the establishment of a publication, periodical or otherwise, of the institute's scientific proceedings and contributions.

Fifth, the institute may originate any other work for the increase of original scientific knowledge of biological or kindred subjects.

In this fifth and last statement of purposes General Wistar, with characteristic astuteness, leaves the way open for any form of biological research.

I have often wondered if he had doubts of the value of the museum for future biological research.

The conditions and limitations of General Wistar's trust deeds (of which there are three) are intricate and exacting and the penalties for infraction severe.

Owing to the emphasis of the museum idea, it was quite natural that the early development of the institute should have been along museum lines.

Dr. Harrison Allen, the first director of the institute, was a physician of exceptional attainments in his specialty and with an extensive practice. Notwithstanding this time-consuming occupation, he set aside a certain portion of each day for his studies in zoology and comparative anatomy.

Well do I recall his daily program, for it was my privilege to dissect with him on certain days of each week. The hours were from 6 A. M. until breakfast time. Frequently breakfast was delayed because of his interest in the study on hand and patients waited impatiently in his office for him to arrive.

Dr. Allen's scientific mind, his experience in the practice of medicine and surgery, and his long devotion to research in zoology and comparative anatomy, subjects which he had taught for many years in the auxiliary faculty of medicine of the University of Pennsylvania, gave him unique qualifications to outline the policy of an anatomical institute which had come into being through the efforts and stimulus of medical men. To him the accumulation of a museum of research materials was especially to be desired.

The study of race types was to him important. "Why," said he, "should the negro succumb to pneumonia more readily than the white man?" Dr. Allen emphasized the study of comparative anatomy for the better understanding of man and for the value of such knowledge in alleviating human ills. He was one of the first in Philadelphia to use diphtheria antitoxin, and that on his own daughter.

Dr. Allen's ideals for the development of an anatomical institute were all that could have been expected thirty years ago and were the precursors of those that have followed.

Dr. Allen resigned on July 2, and Dr. Horace Jayne was elected to succeed him on October 3, 1894. Dr. Jayne was also a devotee of comparative anatomy and had been professor of vertebrate morphology in the Biological School of the University of Pennsylvania—a department which he had organized and for which he had built and equipped a building.

Dr. Jayne's enthusiasm for the development of a great museum of comparative anatomy was demon-

strated by his generous contribution of a large series of mammalian osteological and other preparations, by his gift to the library of a valuable collection of about 1,000 volumes of bound periodicals relating to zoological subjects.

An elaborate museum scheme was proposed by Dr. Jayne, setting forth the manner in which a morphological museum would be developed.

This plan contemplated a museum consisting of two parts:

First, the reserve collection for original investigation and exchange.

Second, the educational exhibits, an elaborate series of labels illustrated by preparations.

The educational exhibits were to include the following subjects:

1. Systematic anatomy, treating of the different systems of organs.

2. Topographical and surgical anatomy, treating of the different regions of the body from the surgeon's viewpoint.

3. Embryology, the development of the human body.

4. Teratology, treating of malformations.

5. Morbid anatomy, including changes in structures produced by different general diseases.

6. Physical anthropology, dealing with the races of mankind; and

7. Special subjects, such as artistic anatomy.

In the light of some years' experience, it would seem that any one subdivision of this museum plan would be sufficient for one institution.

The scheme was put into effect to a limited extent in the series of exhibits on the osteology of the human skull.

During the ten years following, a large portion of the institute's resources was expended in devising and constructing museum cases and fittings, porcelain and glass display receptacles for dissections, and mountings for preparations. The metal-glass museum case was the first of its kind to be made in this country and remains yet to be excelled for its purpose.

By gifts and by purchase a large amount of material for the study of comparative anatomy and systematic zoology was accumulated. Among this material are human skeletons, crania and human brains from distinguished individuals; a large collection of zoological materials from Borneo and the Luchu Islands, and mammalian fossils from Florida.

During the ten-year period ending in 1904, more than ten thousand specimens had been added to the museum collection. Dr. Jayne had completed and published the osteological section of his Comparative Anatomy. A number of guests had pursued investigations in the laboratory or used the materials of the museum. No research had been pursued or papers published by any member of the staff during this period.

On December 10, 1904, Dr. Jayne resigned, and on January 11, 1905, I was elected director. During all this early period I had served as assistant director. The first task of the new director was to review the work of the institute since its incorporation and to take stock of assets in their various forms.

The affairs of the institute were summarized about as follows: The institute has a good (museum and laboratory) building with equipment; a modest yet increasing endowment; a museum containing much valuable material. Its independent organization, under protection of the university, would permit it to render a national as well as a local service. Its relations with other institutions, societies, and scientific men have been limited. The research to its credit is unfortunately meager. Its purpose, in the last analysis, is to advance anatomical and biological science.

Much time was spent in visiting other laboratories and consulting prominent zoologists and anatomists whose advice I believed would aid the institute in its endeavor to serve biological science.

Through numerous interviews with active investigators, I was impressed with the fact that there was a growing tendency for cooperation in research. Special institutes were being organized to promote investigations in special fields. The astronomers had led in cooperative investigations.

There was a desire on the part of biologists for central institutes through which studies might be encouraged and correlated. Special societies had been established to discuss problems and stimulate research. Journals had been founded for the publication of results. The question arose: Why should The Wistar Institute not take part in this nation-wide advance in biological science?

The organization of an advisory board of The Wistar Institute, whose members should be chosen from the leading anatomists and zoologists of the country and who should meet at The Wistar Institute periodically to formulate a scientific policy for the institute, appeared to be the most feasible method of placing the institute in active research service and of accomplishing what the University of Pennsylvania and General Wistar had planned. After certain preliminary steps in presenting the plan for approval of the Board of Managers and especially for the approval of General Wistar, it was agreed that the institute should invite ten of the twenty or more anatomists and zoologists, whom I had consulted, to hold a conference at the institute to consider methods

of extending The Wistar Institute's activities and usefulness in biological science.

The anatomists and zoologists invited, and their university connection at that time, were as follows:

1. Professor Lewellys F. Barker, University of Chicago.
2. Professor Edwin G. Conklin, University of Pennsylvania.
3. Professor Henry H. Donaldson, University of Chicago.
4. Professor Simon H. Gage, Cornell University.
5. Professor G. Carl Huber, University of Michigan.
6. Professor George S. Huntington, Columbia University.
7. Professor J. Playfair McMurrich, University of Michigan.
8. Professor Franklin P. Mall, Johns Hopkins University.
9. Professor Charles S. Minot, Harvard University.
10. Professor George A. Piersol, University of Pennsylvania.

On April 11 and 12, 1905, these anatomists and zoologists met at the institute. The conference was opened with an address by General Wistar, who spoke of the foundation of the institute, its resources, and the objects for which it was organized. During the course of the two days' session a scientific policy was outlined and at General Wistar's request the advisory board was established as a permanent feature of the institute.

To-day, twenty years have elapsed since this important event in The Wistar Institute's history, and it is somewhat through sentimental reasons and somewhat because of our belief in the policy of the institute as worthy of emulation that we take pleasure in celebrating this event.

Through all these years this board has met regularly, once each year, to discuss the scientific policy of the institute. The only exceptions were in 1913, when there was no business to transact, and in 1918, when, owing to war conditions, the meeting was not called. Two meetings were held in 1909.

All meetings, excepting two, have been held here at the institute in April. For convenience of its members, one meeting was held on December 28, 1909, at the Harvard Medical School and one on December 28, 1914, at St. Louis, Missouri. Attendance at these meetings has been remarkably full. Seldom has a member been absent.

Seven of the ten original members are still with us. Death has removed three: Dr. Charles S. Minot on November 19, 1914; Dr. Franklin P. Mall on November 17, 1917, and Dr. George A. Piersol on August 7, 1924. I can not pass without expressing my sorrow in the loss of three members to whom I am personally so much indebted for advice and assistance during the early years of my service as director.

There have been added to this board in the order named, Dr. M. J. Greenman; Dr. C. E. McClung, of the University of Pennsylvania; Dr. Ross G. Harrison, of Yale University, and Dr. C. M. Jackson, of the University of Minnesota.

The existence of advisory boards in various enterprises and under various names is not at all new. The operations of this board, however, have been unique, and since its organization similar boards have been created in connection with scientific institutions. The most recent instance is that in the reorganization of the Academy of Natural Sciences of Philadelphia.

An individual may err in the execution of a detail with no special damage to an institution. But the formulation of a general policy of conducting a research institute is a serious matter where the dangers of personal prejudice, personal interest, and unwisdom should be avoided. The activities of a scientific institution should be coordinated with other agencies seeking the same goal. This is where the advisory board functions.

During these two decades the advisory board has considered and made recommendations to the board of managers on all major undertakings of this institute. It has suggested the type and field of research which the institute could most effectively follow; it has suggested the personnel of the scientific staff; it has brought the institute into close cooperation with the American Association of Anatomists and the American Society of Zoologists—the two societies which send official representatives to attend this celebration.

Through its efforts and suggestions, the several publications issued by the institute have been brought together under one management.

There is another side to the conduct of a scientific institution, namely, the proper administration of the business of the institution. Here the abilities of the man of affairs is essential.

There are financial questions to consider, mechanical problems to deal with, legal matters to be settled. Here the board of managers, comprised as it is of lawyers, business men, engineers, doctors, as well as scientific men, plays a very important part in the conduct of this institution. With them rests the final authority in all matters of conduct of the institute.

The board of managers of this institute has followed the recommendations of the advisory board as closely as finances and other conditions would permit. Only by this harmonious cooperation has success been possible.

Time and space permit me to indicate only the most conspicuous achievements during the twenty-year period just closing.

If I contrast the results of the institute's activities during its first eleven years of work under what we may call a museum administration (1894–1905) with those of the past twenty years under what we may call a research administration (1905–1925), it will not be for the purpose of minimizing the genesis of the institute, but rather to demonstrate what may be accomplished by concentration and cooperation and with very modest expenditures.

In 1905 the personnel of the institute consisted of eleven individuals. In 1925 there are forty-five persons engaged in work of the institute.

During the first eleven years of the institute's corporate existence, two guests pursued investigations in the laboratory and published ten contributions—a total of 631 pages credited to the institute—while a number of investigators used the materials of the museum for taxonomic work or for investigations not credited to the institute. During this period the staff of the institute published no research.

During the twenty-year period just terminated there have been published from the laboratories of this institute 277 papers containing 6,134 pages—an average of a little more than one paper per month—by members of the staff and by guests who have found it advantageous to spend time, varying from a few months to three years, in the pursuit of advanced work in anatomy in the institute's laboratories. In addition, cooperative research has been pursued with thirty-seven individuals.

Concerning the research, you will hear from Dr. Donaldson of the work that has been accomplished. To his wisdom and ability to direct research the institute owes its achievements in this field of its activities.

While the museum has received much less attention during the past twenty years, at the same time, as a result of laboratory research, there have accumulated many unique preparations useful for future investigations. A striking example of such material is the collection of opossum embryos made by Dr. Carl Hartman and Dr. C. H. Heuser in Texas and used for their embryological researches.

During the early or museum period of the institute's history no periodicals were issued. Early in the beginning of our twenty-year period (1908) five zoological periodicals of national importance were brought together under one publishing management at the institute.

These journals have been expanded and their distribution widely extended. To this number have been added a monograph series, appearing irregularly, and a bibliographic service, which issues authors' abstracts of papers well in advance of their appearance in the journals. During this period the institute has published 80,445 pages in these several journals, issued bibliographic service cards for 2,706 papers, published five books, and issued three numbers of the *Tohoku Journal of Experimental Medicine*, and one number of *Science Reports* for the Tohoku Imperial University at Sendai, Japan.

The Japanese journals were issued temporarily, at the request of the Japanese government, until presses destroyed in the earthquake of September 1, 1923, could be replaced. You will learn from others concerning the work and influence of The Wistar Institute publications. I should like to say in passing that through the advisory board the publication enterprise has developed as an important factor in the promotion of American biological science. The journals published by the institute reach practically every laboratory in the world where similar work is pursued.

Turning now to the business aspect of these two periods. The expense of operating the institute during 1904 was $21,516.90, the endowment income at that time was $23,893.71; twenty years later this expense has increased to $132,547.46. The endowment income is about $48,000.00 at the present time. It is needless to say that we have sought and secured funds from numerous other sources during the past twenty years.

The most liberal contributor to the work of the institute has been Mr. Samuel S. Fels, of Philadelphia, whose generous contributions have made it possible not only to extend the research, but also to provide additional facilities.

In this connection I would like to commend the peculiar wisdom of extending the field of research of an existing institution rather than establishing a new one, and thus avoid the duplication of the inevitable overhead charges which every institution must carry. There have been a few striking examples of such economy quite recently.

Along with its development as a scientific institution came increased endowment provided by General Wistar. In his will General Wistar left to this institute his entire estate save for some modest bequests to his immediate family.

General Wistar's gifts to the institute were so arranged that funds become available as he thought they might be needed. He believed in the gradual evolution of an institution and made provision accordingly. The institute during the past twenty years has developed much more rapidly than he had perhaps expected. Its total endowment to-day is $1,166,818.35 and there is yet to be added a residuary estate which will add about two millions to the present endowment.

The present endowment is inadequate to carry on the work of the institute. Not that the institute is

ever living beyond its means, but philanthropic individuals have encouraged us to extend the work and have provided the funds for such extension. During the past twenty years a very considerable additional equipment, in buildings, machinery and apparatus, has been added.

For the better safeguarding of the present buildings and to provide for future development, the institute purchased in 1902, from the city of Philadelphia, the old police station property at the intersection of Spruce Street and Woodland Avenue. This property was deeded to the Girard Trust Company for the uses of The Wistar Institute subject to all the conditions and limitations of General Wistar's trust deeds. It was remodeled in 1913, and is now used for purposes of the institute.

The necessity of a special building for the breeding and care of albino rats for research purposes became very urgent, owing to the irregular results obtained with animals not raised under the most favorable conditions. In 1921, through the generosity of Mr. Fels, a unique building, designed especially for this purpose, was erected and put into service the following year at a cost of some $43,000.

From this colony many laboratories and individuals are now supplied with clean, healthy stock for research purposes. The success of this unique animal colony is due to the exacting methods of its curator, Miss F. Louise Duhring. In 1924, the nucleus of a colony of Wistar Institute albino rats was sent to London to supply investigators in Great Britain with the same strain of animals that has furnished most of the records now existing on the albino rat.

Early in 1924, a complete press equipment was installed and put into operation for printing the six journals issued by the institute. This was done primarily to reduce the deficit in publishing the journals, which during some years had reached a maximum of nearly $12,000.

During 1924 the income from journal subscriptions and sales was sufficient to meet all expenses. This was the first time in the sixteen years' publication experience that there has been no deficit to meet.

Not only has The Wistar Institute Press been an advantageous investment, but it has also presented certain other unexpected advantages, such as the production of cleaner proof, the making of last-minute changes or corrections, and the production of better illustrations when done under the supervision of those who know what an anatomical illustration is expected to show.

To complete the present equipment, the last addition to the institute's buildings was a boiler house and new boiler, which will make it possible for the institute to use all its available working space at all seasons of the year.

In preparing this sketchy outline of the institute's history, I am reminded of many struggles which beset our way, especially in the early days of inexperience. The institute was and still is a relatively small institution, its endowment income was originally very modest, hardly more than enough to maintain the building with its museum.

There were insufficient funds to provide assistance of the various kinds required, and it fell to our lot to become familiar with many phases of the process of building, equipping, and maintaining an institute. Perhaps we gained wisdom through labor and persistent effort to build an institution worthy of its name. Be that as it may, it is a pleasure to make acknowledgment on behalf of the institute to those who have aided in this task, including members of the advisory board, who took valuable time of busy lives to come and counsel with us; to members of our board of managers, who have always been enthusiastic and willing to carry out the plans presented, and to the members of the staff who have worked together as a unit to add to human knowledge each truth revealed by the patient, persistent method of the laboratory.

One of the chief functions of the institute, while pursuing a well-defined program of research, is to furnish opportunity for younger investigators to establish themselves in their chosen field of study. They are the men and women of originality and of initiative.

Untrammeled by rules or regulations, they pursue their quest with unmitigated zeal. To them the institute is literally never closed.

During this twenty-year period, eight members of the scientific staff (six men and two women) have been called to fill important positions in other institutions; six of these positions were of professorial rank.

Nine guests in the laboratory (seven men and two women) have passed on to important positions in other institutions, and this number does not include the Japanese guests.

Sixteen Japanese advanced students have pursued researches in the laboratories. With one or two exceptions, these men were selected students sent by the Japanese government. They are, without exception, men of unusual ability, earnestly devoted to their work.

Of this number thirteen have already received their advanced or higher degrees in Japan by reason of their work at The Wistar Institute and now occupy prominent positions in their native land. Thus, of

sixty guests, including all grades, thirty-one have established themselves in their special fields of research and have been called to advanced positions. The admission of guests of this type has now become a well-established practice.

During the twenty-year period we have lost by death one member of our staff, Dr. J. M. Stotsenburg, a loyal friend of the institute, who passed to his reward on January 2, 1922.

Of the original staff of 1905 only three remain: Miss Clara N. Perine, who was secretary and clinical assistant to Dr. Harrison Allen when The Wistar Institute was incorporated, and familiar with many of the confidential conferences and influences which led to the organization of this institute. Miss Perine came to The Wistar Institute in February, 1903, and while her official duties are those of librarian, duties which she performs with efficiency, at the same time her capacity to handle financial details has brought to her an important responsibility, and during all these years her assistance in the institute's business office has been invaluable; Dr. Donaldson, whose long-time program of intensive research in a limited field has earned the generous recognition of the entire zoological world and who with his coworkers has laid the foundations for mammalian anatomical and physiological investigations for generations to come, was elected to the staff on December 18, 1905.

And as the third of this surviving triumvirate, I record my own presence as one who has watched the development of the institute from September 1, 1893.

If I might be permitted to use the anthropologists' method of stating age, I would say that The Wistar Institute has three ages, the chronological age (of 117 years), dating from 1808, when Caspar Wistar began the preparation of the first museum specimens; the intellectual age (of 32 years), dating from 1893, when the University of Pennsylvania realized what might be accomplished by creating a biological research institute, and finally the biological age (of 20 years), dating from 1905, when the institute organized its advisory board and began its productive existence.

MILTON J. GREENMAN

THE WISTAR INSTITUTE OF ANATOMY AND BIOLOGY, PHILADELPHIA, PA.

RESEARCH AT THE WISTAR INSTITUTE, 1905–1925[1]

IT is my privilege to give an account of the research work at the institute during the past nineteen years, and in this connection the history of our research program should be considered. As the present occasion admits of certain intimacies, I shall, in this consideration, venture on some personal reminiscences, confident that you will not misinterpret the intent.

In 1890 I made an anatomical study of the brain of the blind deaf-mute, Laura Bridgman. Laura was a normal child up to the end of her second year. At this age she was attacked by scarlet fever, which destroyed all the organs of special sense and left her a pathetically distinguished figure for the remaining fifty-eight years of her life. To interpret the changes in her brain it was important to know the phase of its development just before her illness. For reasons easy to understand, it was not possible at that time to get young brains by which to determine this, so I turned for help to the literature. No help was forthcoming. The search of the literature revealed, moreover, but scanty information concerning the growth of the human nervous system between birth and maturity. Here was a gap—a gap covering the period of the development of the mind. It caught my attention, and the desire to help in closing this gap dominated my subsequent work.

The meager information gathered from the literature was put in a small book, "The Growth of the Brain," published in 1895. The preparation of this book helped to clarify my ideas and also it helped in formulating the problems needing solution, if a fairly complete account of the growth changes in the nervous system was to be obtained. Quantitative work on the nervous system was largely lacking at that time, and to meet this lack it was planned to use, so far as possible, the quantitative methods of weighing, measuring and counting, in addition to those usually employed. Further, as it is always necessary to work with preserved material, a systematic effort was made to determine to what degree the methods of preservation modified the weight and dimension of the nerve tissues. Such was the platform from which our problems were regarded.

Dr. Adolph Meyer in 1893 gave a course on the anatomy of the nervous system in the neurological laboratory at Chicago. For this course he used the albino rat, and thus this animal was brought to our attention. The surviving rats were left in the laboratory and further used, so that gradually those working with them grew to appreciate the fact that for many purposes, and especially for the study of growth changes in the nervous system, the albino rat was an ideal animal. Although the information sought was especially desired for man, yet it had been strongly impressed upon me that the human nervous system was hardly attainable for growth studies, and, when obtained, rarely in proper con-

[1] Read at the celebration of the twentieth anniversary of the Advisory Board of The Wistar Institute, April 13, 1925.

dition for those proposed. Furthermore, experimental work on man was out of the question. Some lower mammal was required for such investigations, while the rare cases in which suitable human material might come to hand could be utilized as controls. The rat enabled us to pursue investigations of this sort, and with its use the work in Chicago laboratory was conducted.

In the conferences at the St. Louis Exposition in 1904, Dr. Mall—pleading modesty—insisted that I replace him on the anatomical program. My paper prepared for that occasion dealt with the need for quantitative studies in anatomy. It was published in SCIENCE, caught the observant eye of Miss Perine, was passed to Dr. Greenman, and, after several intermediate steps, brought about my appointment at the institute in 1905.

The conduct of research at the institute was entrusted to me, with full freedom to develop a program. Quite naturally, the program which was adopted grew out of the earlier experiences that I have ventured to recount. Broadly phrased, this program was as follows: Studies on the postnatal growth and development of the mammalian nervous system as illustrated by the nervous system of the albino rat.

It was recognized that the relations of the work to man were of prime importance, that the nervous system was but a part of the whole animal, and that in the study of structure, technique was a servant, not a master, and thus every sort of technical method that helped was in order. In a word, then, it was our purpose to focus on the rat all the knowledge we could command in the hope of thus determining what influences were at work in the postnatal growth of its nervous system.

Without some explanation the purpose and course of our investigations are not readily understood. Misunderstandings have occurred. May I offer the "retort courteous" to a comment that is sometimes made. It is remarked, "you are interested in rats," with the suppressed clause, "not interested in other things." This is hardly a fair statement. The comment could be paralleled by remarking that an investigator who used a kymograph was interested in kymographs, and his interest stopped there. Of course, we delight in the cleverness and behavior of our chosen animal, for it is our desire to know him as intimately as possible, but from the standpoint of the research laboratory, the rat is merely an animal form with which certain problems can be studied, while, from the standpoint of science, it is the problems themselves that have a lasting importance.

A research program is indispensable for coordinate progress. It may be an excellent program or one that is mediocre, but it is always an aid and a guide. Given a program, however, the question always arises as to how it can be put in practice. Such a program assumes the presence of research men—in themselves a first-class problem. When an investigator comes to work at the institute, several questions arise: What does he wish to do? What can he do? What should he do? Finally, can he take part in the program of the laboratory? No investigator is ever asked to do anything which is not for his individual and scientific welfare. For the most part, those who come to the institute are in the early stages of their scientific work and do not bring their problems with them. It is for us, therefore, to suggest one. In the very nature of the case we are inclined to suggest some investigation that will add to our information concerning the rat, but in so doing every effort is made to select a topic which fits with the investigator's professional interest, his previous experience, and his special aptitudes. As a consequence of this adjustment to the worker, there is a spottiness in the results as published. The researches which appear are often apparently far separated in their subjects, and, at first sight, this is a bit confusing. With a large staff selected for the purpose, continuous progress in a definite direction could be made; but, under conditions as they are, the result which appears is the only one to be expected, and the reason for it lies in the fact that the development of the worker is given precedence over the orderly conduct of the work. In the end such a policy will yield more for the advancement of science than would one by which the worker was fitted to the next problem in the series by some Procrustean procedure. All the time, however, there is a prepared plan in the background, and the relation of each research to this general scheme is carefully noted. Such is the manner in which our research has been arranged.

The scope of the work needs perhaps a word of explanation. The guiding thought is progress from the general to the particular; from the large features to those which are minute. Thus, work began with a study of the growth of the entire animal; that of the nervous system followed. At this point it was evident that the growth of the nervous system should be viewed against that of all the organs, and to this end a long series of studies was made on the growth of the several organs in weight. This series of data has been assembled, and, with similar data from other laboratories, put into a memoir under the title of "The Rat." One result of these accumulated studies is that the investigator has now available a greater body of precise and coordinated information for the albino rat than for any other mammal, not excepting man.

As an aid in obtaining orderly data which will

interlock, the custom of dealing with papers used by the distinguished physiologist Carl Ludwig has been followed. The papers by the younger men have been, in every case, read critically by some member of the staff familiar with the field, and the new observations brought into relation with those previously published from the institute. Such criticism assists the younger writer in several ways and also makes it possible to tie together the results of consecutive studies in a manner that gives them cumulative value.

The formal arrangements for research at the institute include a permanent staff supplemented by investigators who come from time to time for short periods of study. One object in arranging for this second group of workers is to give men who have obtained the doctor's degree a chance to establish their own research work before assuming academic responsibilities. In the work of the staff the peculiarities of institute conditions are recognized and the endeavor made to cooperate in a certain way with university laboratories. Recognizing that long-time studies, those to be carried on for years, are more feasible under institute conditions than under university conditions, the emphasis in our staff work has been put on the sort of research for which our conditions were peculiarly suitable. It was felt that by proceeding in this manner the advance of science would be most aided, as each type of laboratory would utilize its own facilities to the best advantage.

In connection with the plan for long-time work at the institute, a word may be said about the albino rat itself, as it is an integral part of such a scheme. This is a domesticated animal always living under human care. Our first rats were brought from the Chicago colony and kept in a few cages in one of the laboratories. Later a larger colony was developed on the lower floor of the Police Station building. Finally, in 1922, through the generosity of Mr. Fels, a model colony house, planned by Dr. Greenman, was built and stocked with thoroughly clean, vigorous animals. There, under the watch and ward of Miss Duhring and her aids, a remarkably sound and prolific strain of rats is maintained for use in our own laboratories and for distribution to others. This matter is mentioned because the albino rat has been selected as our laboratory animal, and all the care and attention it receives make for constancy in its structure and functions, thus giving us an animal standardized as nearly as possible. Such an animal is to the biologist what pure chemicals are to the chemist. Experiments can be repeated through successive years with assurance of the constancy of the materials. This is no small matter, for the rat is highly responsive to its surroundings and food, and may be greatly modified by changes, especially unfavorable changes, in these conditions.

I turn now to consider the results of the past nineteen years of research. Within this period there have been published 202 scientific papers representing work done under the direction of the institute. Of this, sixteen represent studies carried out in other laboratories. In every case the investigators have received full personal credit for their work, while the institute has enjoyed the reflected glory. This is as it should be, for it is the virtue of academic laboratories that the emphasis is put on the individual rather than on the institution.

To the outer world the institute presents the picture of a cluster of investigators, yet this group has worked as a coherent and cooperative unit—and in cooperation is found the best basis for substantial progress.

It is not suitable here and now to enter into details concerning the researches which have been conducted, nor can the value of individual achievements be assessed. It is possible to indicate merely the larger phases and results, and these only in a general way. Of the 202 scientific studies which have appeared, 174 are on the anatomy and physiology of the rat, and of these, 65 deal with the nervous system. On breeding and reproduction there are 19, and some 34 are concerned with the endocrine glands. The outstanding groups of researches are those on growth, to which Dr. Hatai has contributed with such insight and appalling zeal; those on breeding and domestication, to which Dr. King has given unremitting thought and care for many years, and those on the ductless glands, a field in which the work of Dr. Hammett is distinguished by reason of his studies on the effects of removing the thyroid and parathyroid glands—effects which he has interpreted not only by the usual methods, but by others of his own devising.

It would be a pleasure to expand this review to include the smaller groups of studies, but such expansions would belong rather to a critical essay than to an address. So I pass on to some of the more general results.

As an outcome of these investigations at the institute, we know the life-history of the albino rat as a laboratory animal: its growth and some of its functional activities. From the data accumulated tables have been formed which can be used for reference, and by their aid successive studies in our own laboratory may be fairly compared and a similar comparison is possible with work done elsewhere. The rat lives thirty times as fast as man, and the growth changes in the nervous system—the most conservative of the systems—are in accord with this age

relation. As a consequence, observation on this system can be carried over to man at the equivalent ages. This removes an objection which is often made to studies on animals, namely, that the results can not be directly applied to the human case, since for the rat the contrary is true.

The best food for the rat is that used by well-nourished men. It has no dietary idiosyncrasies, thus differing from other laboratory mammals and furnishing the investigator with a test animal whose nutritional chemistry is similar to that of man.

Sugita showed that the number of cells in the cerebral cortex is a species character and made it highly probable that the difference between large and small brains in a given species is normally due to the fact that the constituent neurons vary in size rather than in number. The Kochs followed the chemical differentiation of the brain from birth to maturity—a record which still remains unique and has yet to be fully utilized. By partial inanition the growth of the brain can be diminished and the proportional weight of its divisions changed. Dr. King has shown that the rat thrives when most closely inbred even for fifty generations.

Critical periods in growth at puberty and before have been noted by Hatai and by Hammett. Finally, in the course of this work, the significance of temperament in the rat has been revealed. Rats stop growing when their familiar caretaker is absent; the isolated intestinal segment is untrustworthy as an indicator, unless the rat was at ease before being killed and was quietly anesthetized. When the thyroid apparatus is removed from rats which still show defense reactions, the mortality is 79 per cent., but when they have been made gentle and fearless through personal care before the operation, it drops to 13 per cent., as shown by Hammett's records. What appears here in the case of the rat is undoubtedly true for other laboratory animals as well, so that these observations have a general application. In this sketch of our research, I have limited myself to those results which appear to have the most general bearing at the moment, though it must be remembered that results not included here may, almost any day, reveal an equal value.

I have been speaking as though research was a pursuit which could be followed for the wishing, but such is hardly the case. Funds, facilities, and endless time-saving devices must be gathered, contrived and kept going. Some one must bear this burden, and if we have succeeded, in a measure, in carrying out our research program, it has been largely accomplished through the constant cooperation of the director of the institute—Dr. Greenman—a natural investigator temporarily engaged in administering a scientific institution. To him much is due.

The report that has just been made is a "report of progress," but the committee does not "ask to be discharged," for the future is most enticing. In response to the initial impulse, which came from the study of Laura Bridgman's brain, the foundation course of our pyramid has been in a large measure laid down. We have some notion of the gross structural composition of the rat and growth records for many of the organs. The way is open now to a more extended examination of the growth of the nervous system against this background. In one direction this means histology; in another, physiology, represented by studies of the relations of the several ductless glands to this growth process—studies like that already made on the thyroid and parathyroid—and then a study of combined deficiencies, all of these directed to the same end: a determination of the modifications in the growth of the nerve tissues which may follow. Not only is the histology of the nervous system during growth waiting for further study, but also that of the more important organs, for, with their change in weight, structural modifications must occur, and thus a series of alterations is taking place which can be followed both by histology and chemistry. So much at least is in the near foreground. We can only hope, as we do with full assurance, that the research at the institute will progress in the future under as favorable conditions as those which have surrounded it during the nineteen years just elapsed.

HENRY H. DONALDSON

THE WISTAR INSTITUTE
OF ANATOMY

SCIENTIFIC EVENTS

THE REPORT OF THE LONDON ZOOLOGICAL SOCIETY

FELLOWS of the Zoological Society, London, received, on April 14, the report of the council and auditors for the year 1924, issued in anticipation of the annual general meeting held on April 29. According to an abstract in the London *Times* it showed success in every direction. The gate-money was £69,219 for the gardens and £23,059 for the aquarium; the total number of visitors was 2,057,146, and the income from fellows' subscriptions was over £15,000, all these figures being "records" in the history of the society. The council attributes these results partly to Wembley, which brought an increased number of visitors from the provinces and from abroad, but also partly to the general improvement in the gardens and the collection and to the new aquarium. If the Zoological Gardens

were a commercial undertaking it would be in a position to declare a good dividend, although it has to pay many thousands of pounds in rent, rates and taxes. But it is debarred by tradition and by its charter from distributing "profits" and devotes any surplus to improvements in the gardens and the collection and to further scientific work.

The report states that out of the surplus from 1924, after discharging the remaining capital expenditure on the aquarium, a scheme of improvements which will occupy several years has been begun. The first stage was the construction of a large out-door enclosure for hardy monkeys, consisting of rockwork with caves, separated from the public by a deep ditch, on the principle adopted in the Mappin Terraces. Adjoining this there is a small experimental house, in which more delicate monkeys will be given constant access to fresh air, radiant heat and ultra-violet rays from quartz electric globes. It is expected that these installations, which are placed on the ground to the west of the Mappin Terraces, will be complete and in occupation before Whitsuntide.

The next stage is the construction of a new reptile house on the site now occupied by the old ape house and the summer aviaries. This building must be elaborate and costly, but it is hoped that when completed it will be as beautiful and efficient as the aquarium and much in advance of any arrangements for housing reptiles that have yet been constructed. When the reptile house has been completed the present reptile house will be completely transformed to make it suitable for small birds, and extensive open-air aviaries will be attached to it. The final stage of the present scheme will be the construction of a large new monkey house on the site of the present monkey house and small birds' house. It will provide for all the apes and monkeys in the collection, except those sufficiently hardy to live on the monkey hill. In designing it the devices found successful in the experimental house will be adopted.

The report contains a list of the chief kinds of food and the quantities used in feeding the animals. In 1924 the walrus alone consumed 4 tons 15 cwt. of cod. The carnivores used 440 horses, weighing approximately 220 tons. Over 35 tons of herrings and whiting, 1,590 pints of shrimps, 343 gallons of fresh milk and over 14,000 tins of condensed milk, 128 lbs. of honey, 258 lbs. of ants' "eggs," 77 lbs. of mealworms, 150 bunches of onions, 108 heads of celery, 1 ton 17 cwt. of grapes and 213,085 bananas are items which show the variety of the feeding substances required. The total cost of food for the year was £11,637, fuel cost £2,014 and water £1,291.

RIVER SURVEY OF THE UNITED STATES

IT is stated in the *Electrical World* that to comply with the provisions of the new river and harbor act the corps of engineers and the Federal Trade Commission are gathering data as to the cost of a comprehensive survey of the rivers of the country and information which is expected to establish the need for such a study.

There was reason to believe the survey itself would be authorized in this act, but differences of opinion among those most interested in obtaining the legislation prevented that action. The law does provide, however, for a report setting forth the needs for and the expense of such a study. It is known definitely that a very strong report favoring these surveys can be written. While the need has been apparent for a generation, no exhaustive argument supporting such an endeavor ever has been prepared.

General Harry Taylor, chief of engineers, states that his first step in carrying out the mandate of congress will be to call for a report from each of his district officers which will cover the needs of that particular section. This preliminary report will set forth the data obtainable in the files of each office. When these reports have been examined such additional information as may be needed then will be called for.

The Federal Power Commission will confine its work to material which will bring out clearly the need for a nation-wide survey of rivers and streams. Because of lack of engineering data the Power Commission now is compelled to give rights for fifty years without knowing whether or not the proposed power development will fit into the maximum utilization of the stream's resources or the best plan to aid flood control and navigation.

It is not the object of these proposed surveys to go into such detail or to make so careful an economic study as now is in progress on the Tennessee River. That survey alone will cost in excess of $500,000. The idea now proposed is to get an accurate picture of the whole river, the detail to be worked out later as actual development is undertaken.

Congress already has specified its intention to use license fees and rental receipts for these studies. A simple enabling paragraph is all that is needed to make available $250,000 annually for this work. The report which now is being prepared is expected to be so convincing that little further delay will result in securing the necessary legislation.

A COURT OF CHEMICAL ACHIEVEMENT

ACCORDING to an article in *Engineering Chemistry*, chemical products, equipment and processes, in fact, all new developments of American chemistry of the

past few years, will each receive unusual recognition at the Tenth Exposition of Chemical Industries to be held this year during the week of September 28 to October 3 at the Grand Central Palace, New York. Plans for the new "Court of Chemical Achievement," inaugurated at the recent meeting of the Advisory Committee of the Exposition, are rapidly taking shape. Outstanding achievements of American chemistry, whether in the research or industrial field, which have been completed during recent years, will be admitted to the court after they have passed a committee of approval of the American Chemical Society.

The new "Court of Achievement," which bids fair to be the outstanding feature of the Chemical Exposition this year, will be in the form of small unit exhibits together in one large specially arranged group. Among the new products which have been suggested for display are twenty-seven recent developments. This list will probably be increased several times by other new chemical products, instruments and explanation of new processes.

All exhibits will be passed upon and admission to the Court of Achievement will be granted by a committee of the American Chemical Society known as the committee of approval which is composed of Marston T. Bogert, chairman, C. M. Stine, E. R. Weidlein, F. W. Willard and John Johnston. A subcommittee of the Chemical Exposition Advisory Committee, composed of H. E. Howe, chairman, F. J. Metzger and T. B. Wagner, will act in an advisory capacity to the exposition management in the general conduct of the new project.

Entries for new products and processes for the Court of Achievement must be sent to Court of Achievement, Room 1102, Grand Central Palace, New York, prior to May 1, after which time applications will not be considered. A nominal fee will be charged for all exhibits in the court except those of institutions of learning and government bureaus or departments which will be accepted without charge if they pass the judges. A brochure will be printed and distributed from the Court of Achievement at the exposition. Full information can be secured by inquiring at the address indicated above.

THE NATIONAL ACADEMY OF SCIENCES

AT the spring meeting of the National Academy of Sciences held in Washington on April 28, the following members were elected:

Section of Mathematics:
Solomon Lefschetz, University of Kansas.
Section of Physics:
Frederick Albert Saunders, Harvard University.
William David Coolidge, Schenectady, New York.
Section of Engineering:
Ralph Modjeski, Chicago.
Elmer Ambrose Sperry, Manhattan Bridge Plaza, Brooklyn, New York.
Section of Chemistry:
Charles August Kraus, Clark University.
Section of Geology and Paleontology:
Reginald Aldworth Daly, Harvard University.
Section of Botany:
Edward Murray East, Harvard University.
Section of Physiology and Pathology:
Florence Rena Sabin, The Johns Hopkins Medical School.
Harry Gideon Wells, University of Chicago.
Section of Anthropology and Psychology:
Walter Bowers Pillsbury, University of Michigan.
Foreign members were elected, as follows:
Sir Charles Parsons, the British engineer.
Professor Arthur Stanley Eddington, Plumian professor of astronomy in the University of Cambridge.
Dr. Adolph Engler, professor of botany in the University of Berlin.
Dr. Niels Bohr, professor of physics in the University of Copenhagen.
Mr. Charles P. E. Schneider, the French engineer.
Dr. Hans Speman, professor of zoology, University of Freiburg, i. Br.

SCIENTIFIC NOTES AND NEWS

DR. CHARLES D. WALCOTT, secretary of the Smithsonian Institution, was elected president of the American Philosophical Society at the general meeting of the society held in Philadelphia from April 23 to 25.

AS a memorial to Dr. Charles P. Steinmetz, chief consulting engineer of the General Electric Company, the Schenectady Section of the American Institute of Electrical Engineers has initiated a series of annual lectures, to be known as the Steinmetz Lectures. The first will be given on May 8 by Professor M. I. Pupin, of Columbia University, president of the American Association for the Advancement of Science. His subject will be "Law, description and hypothesis in the electrical science."

THE seventieth birthday of Dean M. E. Cooley, of the University of Michigan, was recently celebrated at a general engineering assembly. A large silver loving cup was presented to him by the engineering and architectural students. Upon this cup was engraved the inscription, "An expression of the appreciation and affection of the students of the colleges of engineering and architecture for their dean, Mortimer Elwyn Cooley, March 28, 1925." L. W. Wallace, secretary of the American Engineering Council, of Washington, D. C., gave a eulogy of Dean Cooley and Acting President Alfred H. Lloyd congratulated him on behalf of the faculty and students.

DR. L. O. HOWARD and Dr. A. C. True, of the U. S. Department of Agriculture, represent the United States on the International Commission which is making arrangements for the twelfth International Congress of Agriculture which is to be held at Warsaw from June 21 to 24.

THE board of trustees of the Tropical Plant Research Foundation, at their annual meeting in Washington on April 27, elected as president Professor L. R. Jones; vice-president, Dr. Robert A. Harper, and trustees for five-year terms, Dr. William Crocker and Dr. W. D. Hunter.

DR. F. SODDY, professor of chemistry in the University of Oxford, has been elected a corresponding member of the Russian Academy of Sciences.

DR. F. W. ASTON, fellow of Trinity College, Cambridge, has been elected a member of the Athenaeum for distinguished eminence in science.

IN honor of the sixtieth birthday of Dr. Max Cremer, professor of physiology in the veterinary institute of the University of Berlin, a special number of the *Biochemische Zeitschrift* has been dedicated to him. The University of Cologne has conferred on Dr. Cremer the honorary degree of doctor of laws.

THE Scientific Club of Winnipeg has awarded its research prize of $300 to Miss Mollie Weinberg, M.A., M.Sc., for her biophysical investigations in acoustics and on gustatory sensory reflexes, which were carried out in the department of physics, University of Manitoba, under the direction of Professor Frank Allen.

DR. ALEXANDER WETMORE, superintendent of the National Zoological Park, has been appointed an assistant secretary of the Smithsonian Institution with general supervision of the National Museum, the National Gallery of Art and the National Zoological Park.

CLAUDE B. GOUAUX, of the Louisiana State University, has been appointed by the Tropical Plant Research Foundation to be agriculturist on the staff of its Cuban Sugar Experiment Station, and D. L. Van Dine, entomologist, field director of the foundation's Sugar Experiment Station, with headquarters at Central Baragua, in the Province of Camagüey.

C. H. BURRAGE has been appointed forester in the Robinson Substation at Quicksand in eastern Kentucky, authorized by the state legislature with an appropriation of $25,000 per annum.

DR. BENJAMIN T. TERRY, for six years professor of pathology, Vanderbilt University School of Medicine, Nashville, has been appointed director of pathologic laboratories at the Toledo Hospital, Toledo, Ohio, effective on September 1.

DR. GEORGE R. HILL, JR., has resigned as professor of botany and plant pathology and dean of agriculture of the Agricultural College of Utah, effective at the close of the present school year, and has accepted the position of director of the department of agricultural research with the American Smelting and Refining Company at Salt Lake City, Utah.

THE Society for Experimental Biology and Medicine at its annual business meeting on April 15 elected the following officers: *President,* J. W. Jobling; *vice-president,* S. R. Benedict; *secretary-treasurer,* A. J. Goldfarb; *councilor,* W. W. Palmer; *nominating committee,* C. P. Sherwin, H. C. Sherman, V. C. Myers, H. C. Jackson, D. D. Van Slyke, L. B. Mendel, J. B. Collip.

AT the annual meeting of the Anthropological Society of Washington, D. C., the following officers were elected for the ensuing year: *President,* Mr. Neil M. Judd, succeeding Dr. Michelson; *vice-president,* Mr. J. P. Harrington, reelected; *secretary,* Dr. John M. Cooper, reelected; *treasurer,* Mr. J. N. B. Hewitt, reelected; *additional members of Board of Managers,* reelected, Dr. Chas. L. G. Anderson, Mr. Felix Neumann and Mr. Herbert Krieger, succeeding Mr. Judd.

THE American Engineering Standards Committee announces the formation of a committee of five leading executives, to act as an advisory body to the committee in standardization efforts, particularly as these affect the elimination of waste. This advisory committee will consist of J. A. Farrell, president of the United States Steel Corporation; G. B. Cortelyou, president of the Consolidated Gas Company, New York; J. W. Lieb, vice-president of the New York Edison Company; L. F. Loree, president of the Delaware & Hudson Company, and Gerard Swope, president of the General Electric Company.

AT the annual meeting of the National Clay Products Association in Montreal, the announcement was made that practically the whole sum required for the institution for a course in ceramic engineering at the University of Toronto had been pledged by members of the association. Andrew Dodds, of Mimico, Ont., was elected president for the ensuing year and the following were chosen vice-presidents: D. C. Merkley, Ottawa; B. McFarren, Toronto, and H. F. Bingledine, Aldershot, Ont. The secretary is Gordon C. Keith, of Toronto.

SIR THOMAS H. HOLLAND has been elected president and Viscount Cowdray, Sir John Cargill, Alfred C. Adams, Alexander Duckham, Arthur W. Eastlake

and Robert Redwood have been elected vice-presidents of the British Institution of Petroleum Technologists for the ensuing year.

WILLARD C. THOMPSON, chief of the department of poultry husbandry at Rutgers College and the New Jersey station, has been given a two years' leave of absence to serve as temporary director of the National Poultry Institute of England, recently established at Harper Adams Agricultural College, Newport, Shropshire, with funds aggregating £50,000.

DR. H. S. WASHINGTON, of the geophysical laboratory of the Carnegie Institution of Washington, is in Europe to carry on archeological and volcanological studies in Italy and northern Africa.

EXPEDITIONS in which psychological tests were given to American Indians went out from the University of Denver under the direction of Dr. Thomas R. Garth this spring, one to the Pine Ridge Indian Reservation, in South Dakota, and the other to the United States Indian School, at Rapid City, South Dakota. Nearly one thousand Indian children were tested for intelligence, musical talent, will-temperament, color preference and handwriting.

ANNOUNCEMENT has been made in Berlin of plans for a German expedition to ascend Mount Everest in the Himalayas, under the auspices of the German Alpine Association and under the leadership of Captain von Peiser. The preliminary expedition plans to start on July 2.

DR. EDWIN E. SLOSSON, director of Science Service, Washington, is to give a public lecture in the Sterling Chemistry Laboratory of Yale University on the evening of May 22, under the auspices of the chemistry fraternity Alpha Chi Sigma.

K. S. JOHNSON, of the Bell Telephone Laboratories, Inc., of New York, lectured on "Electric wave filters" before the faculty, graduates and seniors of Yale University on April 21 and 22.

DR. CARLETON R. BALL, senior agronomist in charge of the office of cereal investigations, U. S. Department of Agriculture, delivered two lectures on the subject "Cooperation and research" before the class in organization and method of research in the graduate school of the U. S. Department of Agriculture, during February, and had been invited to address the Special Convention of the Directors of State Agricultural Experiment Stations, at St. Louis, on April 8 and 9, on the subject "Some elements of successful cooperation in research."

DR. J. PARSONS SCHAEFFER, Jefferson Medical College, recently addressed the New York Roentgen Society on "The paranasal sinuses in Roentgenology" and the Montgomery County and the Lycoming County Medical Societies on "Anatomical variation in symptomatology, diagnosis and treatment."

UNDER the auspices of the department of zoology and of the Biological Club, Professor James H. McGregor, of Columbia University, delivered two lectures on "Prehistoric man" before the students of Oberlin College on April 23 and 24.

DR. ALBERT SCHNEIDER, dean of the school of pharmacy of the North Pacific College of Oregon, will give a course of lectures on "General detective methods and police microanalysis" at the summer sessions of the University of California. Arrangements have just been completed for Dr. Schneider to continue his investigations into the probable cause of cancer, begun at the University of Nebraska several years ago.

E. C. RHODES, of the school of economics of the University of London, who served as assistant to Dr. Karl Pearson for several years, will give two courses of lectures at the summer session of Northwestern University. One course is entitled "An introduction to statistical method," the other "The advanced mathematics of statistics."

DR. ALEXANDER KOTLAN, assistant professor and lecturer on zoology and parasitology at the Veterinary College of Buda Pest, is now in this country as exchange professor under the auspices of the American-Hungarian Foundation. He is carrying on investigations in certain poultry diseases in the department of bacteriology in cooperation with the veterinary department of the Michigan Agricultural College. He lectured at the University of Illinois under the auspices of the department of zoology, April 22, on "A survey of our knowledge on the development of parasitic nematodes with particular reference to the migratory phenomenon" and on April 23 on "The pathologic significance of recent discoveries in the field of the development of parasitic roundworms."

DR. L. SILBERSTEIN gave a lecture at the laboratory of the department of terrestrial magnetism of the Carnegie Institution of Washington on April 29, entitled, "Some cosmological consequences of the finite universe." The leaders in the discussion were Dr. P. R. Heyl, of the Bureau of Standards, and Dr. E. P. Hubble, of the Mount Wilson Observatory.

A COMMITTEE presided over by M. P. Appell, rector of the University of Paris, was appointed in 1914 to raise the necessary funds to strike a medal in honor of Henri Poincaré and to provide a prize to encourage students in the study of celestial mechanics, mathematical physics and the philosophy of the sciences. The subscription was interrupted by the war, but has now been resumed by a committee appointed by the Paris Academy of Sciences. Several copies of the medal

have been made, and at the session of the academy on April 30 were presented by President Bouvier to Mme. Henri Poincaré and M. Raymond Poincaré.

SIR RICKMAN JOHN GODLEE, the distinguished surgeon, died on April 20 at the age of seventy-six years. Sir Rickman had been president of Royal College of Surgeons and was the biograhper of Lord Lister.

THE death is announced, at Ann Arbor, at the age of seventy-seven years, of Charles Kasson Wead, who was, from 1877 to 1885, professor of physics at the University of Michigan and later, until his retirement, examiner in the U. S. Patent Office.

THE International Research Council will hold its third meeting in Brussels on July 7. The secretary of the council is Sir Arthur Schuster, professor of physics in the University of Manchester.

THE annual meeting of the British Science Guild was held in London on April 21. Lord Askwith presided and the speakers were Sir William Bragg, Major-General Sir Frederick Maurice, Major the Honorable H. Fletcher Moulton, Sir Arthur Newsholme and Mr. A. A. Somerville, M.P.

THE after-Easter lecture session at the Royal Institution began in April when Professor Barcroft gave four lectures on "Some effects of climate on the circulation." The Tyndall lectures will be delivered by Professor Whiddington on "The passage of electricity through vacuum tubes," beginning on May 19. On April 23 Mr. F. Kingdon Ward began a course of two lectures on "A year's exploration in Tibet." On succeeding Thursday afternoons there will be two lectures by Professor H. J. Fleure on "Prehistoric trade and traders of the west coasts of Europe," and two by Professor F. O. Bower on "The natural classification of ferns." W. P. Pycraft will give lectures on "Use and disuse and their effect on the bodily structure of animals." The Friday evening meetings were resumed on April 24, when Dr. W. A. Craigie delivered a lecture on "The Icelandic sagas." Other lectures will probably be given by Professor W. L. Bragg, Dr. H. H. Dale, Professor H. G. Darwin, Dr. Thorne M. Carpenter and Sir Henry Newbolt.

CHAS. M. UPHAM, director of the highway research advisory board of the National Research Council, announces the extension of the board by the appointment of contact men from the various engineering colleges of the country. At the present time, eighty colleges have responded to the call and have signified their willingness and desire for cooperation by the appointment of a member of their faculty to act with the board. The contact man in every case has been one who has done work along the lines of highway research.

THE first number of a mathematical journal entitled *Revista Matemática* appeared in October, 1924. It was published by the "Sociedad Matemática Argentina," and the first three numbers have appeared monthly.

THROUGH the generosity of Messrs. Watermeyer and Leonhardt, president and vice-president of Fritzsche Brothers, Inc., a research fellowship in the chemistry of perfumes and essential oils has been offered to Columbia University. The fellow is to be appointed by the university council, upon nomination of a committee of award composed of the president of Fritzsche Brothers and the senior professor of organic chemistry at Columbia, and approved by the department of chemistry. The recipient of the fellowship will receive $3,000 per annum and the investigations will be conducted under the direction of Professor Marston T. Bogert.

WE learn from *Nature* that in publishing the first biological number of the Science Reports of the Tohoku Imperial University, Sendai, Japan, Professor S. Hatai announces the formal opening of the biological institute of this university and of a Marine Biological Station, located at Asamushi. Among the special features of this station is an under-sea laboratory and a spacious open marine pool for observations on the growth of marine organisms. Several residences and a large dormitory have been erected where investigators may live with their families and where students may find suitable accommodation. Professor Hatai hopes that his colleagues in Japan and in other countries may take advantage of the facilities offered for research.

THE governing body of the Imperial College of Tropical Agriculture has authorized Dr. Martin Leake, the principal, to arrange for a member of the college staff to visit the east, with a view to combating Panama disease, which has affected the plants in so many parts of the world. At the instigation of the West India Committee, this officer will also take the opportunity of studying limes, with a view to devising a method of meeting the Witherdip disease, which has caused so much damage to the lime plantations of Dominica.

THE French population figures for 1924 show that there were almost exactly the same number of marriages (355,923 to 336,501 in 1923), about 10,000 fewer births and 13,000 more deaths than in the previous year. The excess of births over deaths fell from 94,871 in 1923 to 72,216, but this was an improvement on the 70,579 of 1922. The birth rate per 10,000 of the population declined from 194 in 1923 to 192, and the death rate rose from 170 to 173.

The population is taken as 39,209,518. It may be added that in 1913 the marriage rate was 151 per 10,000, the birth rate 191, and the death rate 176.

UNIVERSITY AND EDUCATIONAL NOTES

THREE million dollars has been collected by the University of Pittsburgh toward the $10,000,000 required for the erection of the fifty-two story building which it is planned to erect.

THE Neurological Institute of New York will become a part of the new Columbia University-Presbyterian Hospital Medical Center.

THE School of Pharmacy of the Pharmaceutical Society of Great Britain has been admitted as a school of the University of London in the faculty of medicine for a period of five years as from January 1, 1925.

WILLIAM W. STIFLER, acting professor of physics at Williams College, has accepted an appointment as associate professor of physics at Amherst College.

HORACE B. ENGLISH, professor of psychology at Antioch College, has been appointed associate professor of psychology at Wesleyan University. Herbert Gurnee (Wesleyan, '22) will also join the department.

DR. C. LADAME has been appointed to the chair of psychiatry in the University of Geneva in succession to Dr. R. Weber, who has been made emeritus professor.

DISCUSSION

DECAY AND REGENERATION OF RADIO-LUMINESCENCE

IT is well known that the luminescence produced in certain materials subjected to the action of the radioactive rays decreases with time and that the color of the luminescence changes, while at the same time the material itself also changes in color. From experimental work covering more than two years and still under way, we are led to believe that the decrease in luminescence of phosphorescent zinc sulfid, etc., is probably due to the masking of the radiation luminosity by the color which the material acquires, due to the action of the radiation.

For example, small glass tubes containing radon initially glow quite brightly with a yellowish-green light, but the glass soon turns either brown or blue, and in the course of a few days the tubes glow very faintly if at all. If the tubes be heated sufficiently to just discharge the coloration, the glow returns. This operation can be repeated with no apparent change in the property of the glass to glow under the action of the radon rays.

The coloration of the glass is not a surface phenomenon, and the color produced, whether brown or blue, seems to reach a color depth beyond which further radiation produces no apparent increase in the coloration.

Since the observation of the behavior of glass under radiation and the restoration of its luminescence by discharging the coloration by heating, phosphorescent zinc sulfid has been investigated. Here again the visible radio-luminescence and the phosphorescence decrease as the coloration increases, and eventually zinc sulfid, which originally gave a brilliant phosphorescence in daylight, no longer responds, and it is only faintly responsive to alpha radiation. However, on heating this zinc sulfid just sufficiently to discharge the coloration, no difference in any of its properties can be detected between such revived zinc sulfid and some of the same material which has not been subjected to radiation.

This investigation is being continued and a more detailed report will be given later.

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BAUXITE AND SIDERITE

UNDER the caption "Bauxite associated with siderite," published in Volume 35, Number 3, of Bulletin of the Geological Society of America, Mr. E. F. Burchard, of the United States Geological Survey, has published a description of the bauxite deposits of northeast Mississippi, the opening paragraphs of which are so worded as to leave an unfavorable impression of the work of geologists who preceded Mr. Burchard in Mississippi. Besides the various members of the State Geological Survey, numerous eminent geologists from other states and from the Federal Survey fall within this list. While Mr. Burchard was in Mississippi he visited the office of the State Geological Survey and was treated cordially and with due consideration, hence I do not think that he intended to be inconsiderate of this department, or of others, in his remarks.

In the opening sentence of his article Mr. Burchard said, "A new bauxite field in northeastern Mississippi was discovered in an interesting way by J. W. Adams, of Tuscumbia, Alabama, in 1921." Then, after quoting Hilgard's description of what has since turned out to be bauxite, he says:

More than sixty years elapsed between the publication

of Hilgard's description and the utilization of the information. In the interval many geologists had been over the same ground in quest of underground water, clays, iron ore, and petroleum, and presumably had read the report, but it fell to the lot of a non-technical, but keen and persevering prospector to interpret the facts and to bring to light this interesting resource. Geologists may, however, console themselves in the fact that the note as published by Hilgard was clear and accurate and that it eventually pointed the way to a valuable discovery.

In the late summer or early autumn of 1921 I met Mr. Adams at Iuka, Mississippi, not by appointment, but a purely accidental meeting. He wished to show me what he thought was a deposit of bauxite just over the state line in Alabama. On examining the material I stated that in my opinion it was bauxite, but that I would like to see an analysis of it before expressing a positive opinion. Then it was that reference was made to Hilgard's description quoted by Mr. Burchard. I am uncertain whether Adams or myself referred to it, but a letter from Adams dated in February, 1922, says, "You remember telling me, when we were at Riverton Junction (Alabama), last summer, that I should prospect over Mississippi for Al_2O_3." I do not recall the exact conversation, but I do remember telling Adams to give me the results of his examinations in Mississippi; and he accordingly, in the late winter of 1922, sent me a very good sample of bauxite from Pontotoc County.

Now, we do not take issue with Mr. Burchard in giving to J. W. Adams the credit of the discovery, which was due him. Credit for this discovery was freely accorded Mr. Adams in our Bulletin No. 19, "Bauxite deposits of Mississippi," by Paul F. Morse, which was put into the hands of the printer in December, 1923, before Mr. Burchard's article was submitted for publication. What we do find hard to explain satisfactorily is why Mr. Burchard was so careful to emphasize in the opening paragraphs of his article that previous workers in Mississippi geology (including the State Geological Survey) had failed to discover these deposits (and they could easily be overlooked by a geologist not especially familiar with bauxite), and at the same time forget so completely to mention that the Mississippi Geological Survey had, at least in a measure, retrieved its reputation by promptly arranging with the prospecting company to secure the results of their accurate and detailed prospecting, which were prepared by Mr. Morse into a full and valuable report and sent to press in December, 1923, as Bulletin No. 19 of the Mississippi Geological Survey, a month before Mr. Burchard's article was submitted; furthermore, that galley proofs of our report were sent to Mr. Burchard, at his request, as soon as they were available, some of the material and maps of which he used in his own bulletin. It seems to me a lapse of courtesy that Mr. Burchard made no mention of these things.

E. N. LOWE, *Director*
MISSISSIPPI GEOLOGICAL SURVEY,
MARCH 19, 1925

CHANCE AND EVOLUTION

So much has been printed in connection with the rejuvenated controversy on evolution that an attempt to add anything might seem presumptuous. Yet it appears to the writer that one of the most pregnant causes of misunderstanding between scientists and representatives of religion has been overlooked.

It is generally taken for granted that evolution is obnoxious to an adherent of one of the current forms of religion because it teaches that he is related to animals and particularly has "a monkey ancestry." This undoubtedly is the dominant occasion for offence in many cases, but there is a more subtle cause of friction which has resulted in much greater damage than the one mentioned. This is, in brief, the constant employment in scientific and particularly in evolutionary literature of such terms as "chance" and "accident" when dealing with origins. Less is said to-day about the "fortuitous concourse of atoms" which, a few years back, excited wrath in theological circles, but the suggestion of accident is nevertheless constantly made in scientific publications and is no less repellent to one who is taught to view the universe as a product of design.

The worst of this is that the offence is wholly unnecessary and could easily be avoided by a frank explanation of what the scientist understands by those terms. For, unless he is unpardonably superficial, he never intends chance and accident to be taken in the sense ordinarily assumed by the man in the street, that of something "hit or miss." In every department of research law is found to rule supreme, and it is in the confident belief that law will continue to be found so ruling that scientific investigation is pursued. If of a hundred facts only four fifths are to-day placed under laws, the scientist does not suppose the remaining one fifth to be beyond the reign of law but that he has not yet discovered the law or laws to which they respond. Chance and accident do not connote to him anything philosophical as opposed to design; they merely signify that the source of the data to which these terms are applied is indefinite. They may be products of design or evolved apart from design, but the student's intention is merely to pigeonhole them in an indeterminate category for further examination.

A striking example of this is the old Darwinian expression "accidental variations," which no evolu-

tionist would, I suppose, take to connote a haphazard origin of the factors so designated, since much investigation has been and is being devoted to a discovery of the causes of just such variations—all of which would be so much time thrown away if they actually respond to no law whatever.

But unfortunately certain would-be popularizers of science and superficial thinkers with scientific pretentions have interpreted these terms in accordance with the popular meaning and have spread abroad an impression that science denies design in nature. Certainly, science does not affirm it, because to do so would be to usurp the functions of philosophy. But she is so far opposed to the haphazard that no one would be more startled than a scientist at the appearance of an absolutely uncategorizable or lawless phenomenon. Science will not deny the possibility of such an apparition, but she will wait to be shown.

Much disturbance of the sensibilities of the religious minded will be avoided and a load of prejudice removed from the minds of great masses of people if teachers of evolution will take pains to explain to their classes the exact sense in which "chance," "accident" and similar terms are understood by scientific investigators.

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SCIENTIFIC BOOKS

TWO RECENT HISTORIES OF ELEMENTARY MATHEMATICS

THE literature of the history of elementary mathematics has recently been greatly enriched by the appearance of two unusually extensive works. One of these was published during the years 1921–1924, in seven small volumes, composed altogether of about 1,300 pages, while the other was published during the years 1923 and 1925, in two volumes, involving together about 1,350 pages. The former was written by J. Tropfke, Oberrealschuldirector, Berlin, Germany, and bears the title "Geschichte der Elementar-Mathematik," while the latter bears the more general title, "History of Mathematics," and was written by D. E. Smith, Teachers College, Columbia University. While both of these works should be of considerable interest to the student of the general history of science, the latter will probably appear especially attractive to such a student.

It may be of interest to note here that the term *elementary mathematics* is used with different meanings by the authors of the two works under consideration. D. E. Smith uses this term for "mathematics through the first steps in the calculus," while J. Tropfke excludes the calculus from the subjects covered by this term, placing its upper limit at the close of the elementary developments in analytic geometry. This is in accord with the fourth edition of volume 1 of the well-known "Encyklopädie der Elementar-Mathematik," by Weber and Wellstein, while the definition used by D. E. Smith is in accord with the earlier editions of this volume, as well as with common usage in our country. Notwithstanding the fact that the work by Smith aims to reach a somewhat higher limit as regards the subjects treated than that by Tropfke it actually presupposes less mathematical knowledge on the part of the reader and pays less attention to the more advanced developments in the subjects considered by both of these writers.

The subtitle of the first volume of this work by Smith is "General survey of the history of elementary mathematics," and in each of its ten chapters a brief sketch of the development of elementary mathematics during a certain period is given, beginning with "prehistoric mathematics" and ending with the mathematics of the "eighteenth century and after." The subtitle of the second volume of the same work is "Special topics of elementary mathematics," and it is also divided into ten chapters, with the following headings, in order: Development of the arithmetica, logistic of natural numbers, mechanical aids to calculation, artificial numbers, geometry, algebra, elementary problems, trigonometry, measures, the calculus. The subject of analytic geometry is treated very briefly in the chapter devoted to geometry and only twenty-seven pages are devoted to the history of the calculus.

The fact that there is now a demand for such extensive works devoted to the history of elementary mathematics is evidence of a rapidly growing interest in the history of science. Teachers of elementary mathematics will find in these works a large amount of material which may be used occasionally to exhibit the fact that the modern form of elementary mathematics seems, in many cases, to have resulted from the survival of the fittest, and to be much more free from difficulties than the earlier expositions. In particular, many elegant results which can now be easily established by means of Taylor's theorem escaped the notice of such shrewd minds as those of Newton and Leibniz, who are commonly credited with the invention of the calculus. The cheerful view that the human race is making actual progress in realms of abstract knowledge and that at least some truths are definite and not merely relative is perhaps supported more strongly by the history of elementary mathematics than by any other subject with which the young students become familiar.

An interesting feature of these works is the fact

that attention is frequently directed to necessary modifications as regards older views. The deeper study of some of the questions considered therein will doubtless give rise to further necessary modifications. The unusually extensive lists of references which they present will be very useful to those who desire to enter more deeply into the study of certain historical questions. Hence it is to be hoped that these extensive works will serve not only as a source of information for those interested in the history of the development of elementary mathematics, but still more as a stepping-stone towards a deeper general insight into this history. The pursuit of such insight rather than the accumulation of historical facts should dominate the student of the history of science.

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SPECIAL ARTICLES

SEROLOGICAL OBSERVATIONS ON THE RELATIONSHIP OF THE BLOODS OF MAN AND THE ANTHROPOID APES[1]

MUCH attention has been paid to the work of Grünbaum[2] and of Nuttall[3] who studied the relationship between man and the anthropoid apes by means of the precipitin reaction. They found that the sera of man and chimpanzee were indistinguishable by this means. In Nuttall's tests with anti-human precipitin the intensity of the reaction decreased gradually in this order: chimpanzee and man, gorilla, orang, lower monkeys. As it has already been pointed out[4] that the antigens involved in the lytic and agglutinative reactions of red blood corpuscles differ essentially from the antigenic proteins concerned in the precipitin reaction, a comparative study of the serological behavior of the blood cells of the primates has been undertaken.

When immune agglutinins against human or chimpanzee erythrocytes (immune rabbit sera) were tested with several specimens of blood of both these species there was found often but not constantly a difference in the titers against the two kinds of blood. These results resemble those with the precipitin reaction. If, however, the method of absorption is employed, a striking difference between the two kinds of blood is brought out, so that there is no difficulty in differentiating the two species. We have been able to confirm this observation repeatedly. In the only absorption experiment performed with orang blood similar results were obtained. As had been expected[5] the reaction showed the differences: man—lower monkeys, and chimpanzee—lower monkeys, to be about equal among themselves and to be much greater than the difference: man—chimpanzee. This finding is in agreement with the view of zoologists that the anthropoids are not placed on a line leading from the lower monkeys to man, but that at a certain stage of evolution there separated one line which developed into the catarrhinae and another leading to the anthropoids and man.

The differences between the races of man were imperceptible by our technique in experiments made up to the present by the comparison of white and American negro bloods.

Of considerable interest was the search in anthropoid bloods for the occurrence of group specific substances similar to those in human blood, especially in view of the information accumulated in recent years by the work of H. and L. Hirschfeld[6] and their followers on the distribution of blood groups in human races. Owing to the complication arising from the presence in human serum of heteroagglutinins for anthropoid blood, the following technique was employed: Human red cells groups II and III[7] were agglutinated by human sera groups III and II, respectively. The cells were washed and the agglutinin separated from them by heating.[8] As a second method immune sera against human group II and group III blood cells were absorbed with human blood cells of group I. The resulting liquids agglutinated specifically group II and III cells, respectively, and served very well for typing the anthropoid bloods. Both methods gave reactions with anthropoid blood in every way identical with those of human blood, while the bloods of other animals behaved differently. These reactions give additional proof of the close relationship between man and the anthropoids.

Of twelve chimpanzees examined three belong to group I and nine to group II. By including the two sera and one blood of chimpanzee reported by v. Dungern and Hirschfeld,[9] apparently belonging to

[1] From the laboratories of The Rockefeller Institute for Medical Research, New York.

[2] Grünbaum, A. S. F., *Lancet* (1902, i), 143.

[3] Nuttall, G. H. F., "Blood Immunity and Blood Relationship," Cambridge, 1904.

[4] Landsteiner, K., and van der Scheer, J., *Jour. Exp. Med.*, xl (1924), 91. *Ibid*, xli (1925), 427.

[5] See H. T. Marshall's experiments on anti-human and anti-macacus hemolysins, *Jour. Exp. Med.*, vi (1901–1905), 347.

[6] Hirschfeld, L. and H., *Lancet* (1919, ii), 675.

[7] Nomenclature of the American Committee, *J. Am. Med. Assn.*, lxxvi (1921), 130.

[8] Landsteiner, K., *Münch. Med. Woch.*, xlix (1902), 1905.

[9] v. Dungern and Hirschfeld, *Z. Immunitsf.*, viii (1911), 526.

group II, a total of fifteen individuals have been examined of which three were group I and twelve group II.

Of five orangs, two were group II and three group III. The only gibbon blood examined belonged to group III.

In several cases the sera were tested on the blood cells of other individuals of the same species and found to contain isoagglutinins according to the rule for human blood.

It can be concluded from the foregoing that very probably the group specific factors characteristic for human blood appeared in the phylogeny of the primates prior to the genesis of man.

When tested with the absorbed immune sera, the bloods of thirteen species of lower monkeys (catarrhinae and platyrrhinae) all yielded negative results. Nor were distinct reactions obtained when they were tested with agglutinin solutions obtained from normal human serum group III. But agglutinin solutions from normal human serum group II agglutinated all eleven bloods of five species of platyrrhinae (new world monkeys) and one lemur and failed to react on all twenty-seven bloods of seven species of catarrhinae (old world monkeys). The reactive substances demonstrable in the bloods of the lower monkeys by these tests evidently differ from those of anthropoid and human bloods because of their failure to react with the absorbed immune sera. Similar reactions also occur in lower animals, *e.g.*, rabbits (see the absorption experiments of von Dungern and Hirschfeld.[9] The unexpected regularity, as exhibited by the tests on old and new world monkeys, suggests that a certain serological factor may be characteristic for a whole zoological family or group, or at least for the majority of its members.

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ORGANIC DIVISION

Catalytic reduction of cinnamic aldehyde to cinnamic alcohol by hydrogen and platinum black: W. F. TULEY with ROGER ADAMS. When cinnamic aldehyde is reduced with such reagents as sodium and alcohol, iron and hydrochloric acid, or even platinum black and hydrogen, there is invariably obtained as the chief product, phenylpropyl alcohol. Only traces of cinnamyl alcohol are ever produced, but certain amounts of phenyl propionaldehyde can usually be found. Small amounts of iron or zinc salts activate platinum black as a catalyst in aldehyde reductions. On the other hand they render the platinum less active for the reduction of olefines. By reducing cinnamic aldehyde in the presence of platinum black and a very small amount of a mixture of zinc and iron salts, it has been possible to cause the first molecule of hydrogen to react only with the aldehyde group with the formation of cinnamyl alcohol without the production of phenyl-propyl alcohol. The product as obtained directly from the reaction mixture melts only a few degrees lower than the pure substance.

The catalytic reduction of alpha-nitronaphthalene: ARTHUR N. PARRETT with ALEXANDER LOWY. A study has been made of the catalytic reduction of alpha-nitronaphthalene to the amine in the liquid phase under pressures of 50 and 100 pounds of hydrogen. A small laboratory autoclave fitted for rapid stirring was used. The nitro cpd. was reduced in glycol with palladium black as catalyst at temperatures from 50 to 100°. Maximum yield 98.4 per cent. Percentage reduction to amine increased with the temperature. Glycerol, water, and isopropyl alcohol were used in place of glycol. Palladium oxide, platinum oxide, and nickel were also used as catalysts. Temperature and time factors were studied with the different solvents. Molten alpha-nitronapthalene was reduced by hydrogen and PdO in 93.9 per cent. yield against a yield of 14.3 per cent. with nickel.

Catalytic dehydration of alcohols by aqueous hydrobromic acid: HENRY D. HIRSCH. Four secondary and two tertiary alcohols were heated in sealed tubes at 100° with about 2 per cent. by weight of 48 per cent. hydrobromic acid. The formation of unsaturated products was followed by titration with standard bromide-bromate solution. The dehydration reaction was found to be reversible. The reaction constants for the dehydration reactions are as follows: sec-Propyl .00073, sec-Butyl .00128, sec-Amyl .00082, sec-Hexyl .00034, tert-Butyl .0045, tert-Amyl .0070.

Ortho-cresaurin: M. GOMBERG and L. C. ANDERSON. o-Cresol can be condensed with carbon tetrachloride or oxalic acid with the formation of ortho-cresaurin (3, 3′, 3″-trimethyl aurin). The constitution of this dye has been definitely established. The free radical of the trimethyl ether derivative has been prepared in solution, and other derivatives have been synthesized. Ortho-cresaurin can be used in acidimetry, its color changing between pH 6.6 and pH 7.6. Its conversion to blue compounds analogous to aniline blue, hitherto unobtainable, has been realized.

Mercuration of aromatic sulfonic acids: LOUIS EHRENFELD. Aromatic sulfonic acids are mercurated with extreme ease on refluxing with aqueous mercuric acetate. Mercuric ions disappear in less than one hour. The following sulfonic acids have been mercurated: benzene-p-chlorobenzene-, p-bromobenzene-, p-iodobenzene-, o-toluene-, p-toluene-, 2,5-dichlorobenzene-, and 2-chlorotoluene-5-sulfonic acid. The products are usually complex mixtures soluble in bases but not reprecipitated by acid. In a few cases water soluble products may be obtained. The product from p-toluene sulfonic acid re-

[1] Baltimore meeting, April, 1925.

acts with iodine to form 2-iodo-toluene-4-sulfonic acid, thus proving that the mercury entered *meta* to the sulfonic acid group. Crystallization from water gives hydrated 2-hydroxymercuri-toluene-4-sulfonic acid. Over calcium chloride this loses the water of hydration, and over phosphorus pentoxide it forms the inner salt.

New syntheses in the benzothiazole group: MARSTON TAYLOR BOGERT and A. STULL. When o-aminophenyl mercaptan or its zinc salt is condensed with aldehydes, the products in all cases examined are the 2-substituted benzothiazoles identical with those obtained when the corresponding acyl halides are used instead of the aldehydes, and no thiazolines are formed. This is in agreement with the work of Hofmann and at variance with that of Claasz. Both bis (o-aminophenyl) disulfide and its zinc salt have been carried through many interesting condensations with aldehydes and esters of bibasic acids, and the products so obtained then used as initial materials for other syntheses.

Some new derivatives of 2-phenyl-benzothiazole: M. T. BOGERT and H. B. CORBITT. The crystalline product obtained by Hofmann when he treated 2-phenyl-benzothiazole with phosphorus pentachloride has been shown to be the 6-chloro derivative. New nitro, amino, sulfo, and other derivatives have been prepared and investigated, as a further contribution to the chemistry of this group.

On the constitution of some thiazole derivatives: F. B. DAINS. When ethylene bromide reacts with a di-substituted thiourea, a thiazolidine is formed in which the more positive group of the thiourea is at (2) and the less positive at (3) of the new thiazolidine. When the sodium salt of a mono-substituted thiazolidone is allowed to react with a methyl halide, the methyl group attaches itself to the Ph.N and not to nitrogen (3) as suggested by Beckerts and Frerich.

Some derivatives of ethylselenomercaptan: E. H. SHAW, JR. and E. EMMET REID. Ethylselenomercaptan reacts with ketones in the presence of dry hydrogen chloride to form mercaptols of the type $R_2C(SeC_2H_5)_2$. These break down on oxidation to form ethylseleninic acid. Sodium ethylselenomercaptide gives the typical reaction for mercaptans with 1,5-butylsulfone anthraquinone sodium sulfonate, the $-SeC_2H_5$ group being substituted for the $-SO_2Na$ group, with the formation of selenium anthraquinone derivatives. Diseleno ethers result from the action of sodium ethylselenomercaptide with mustard gas, its sulfoxide and its sulfone. An analytical method for determining Se in organic compounds has been developed, making use of the Parr bomb.

Nitridation: F. Y. CHUCK. Just as the aquo nitric acid, HNO_3, is an oxidizing agent, so the ammono nitric acid, $H-N=N\equiv N$, is a nitridizing agent. In water solution this acid converts sulfur to sulfuric acid, ethyl alcohol to acetic acid and methyl amine, benzyl alcohol to benzaldehyde, benzoic acid and aniline. In liquid ammonia solution it nitridizes methyl amine to guanidine, hexamethylene tetramine to formamidine, hydrobenzamide to lophine and benzonitrile, benzyl amine to benzamidine. Using NH_2Cl, NH_2Br, or NH_2I in liquid ammonia as nitridizing agent, sulfur and hydrogen sulfide were nitridized to ammono sulfurous and thiosulfuric acids, S_4N_4 to a compound which seemed to be $N\equiv S\equiv N$, the anammonide of ammono sulfuric acid.

Hyponitrites: ALFRED W. SCOTT. Sodium hyponitrite has been made from ethyl nitrite with hydroxylamine and sodium ethylate. The commercially available nitrites of amyl and n-butyl have been substituted for the ethyl nitrite. The reaction has been studied with reference to concentrations, time, and temperature. The best yield of sodium hyponitrite obtained was 13 per cent.

A synthesis of 5-iodo-isatin: A. J. HILL and MARION PFUND. It has been shown by Schulz and one of us that the condensation products of isatin with either diketopiperazine or hydantoin may be used for the preparation of oxindole acetic acid. 5-Iodo-isatin has now been synthesized with a view to preparing iodo-oxindolacetic acid. 5-Iodo-isatin may be prepared by allowing a mixture of isatin, 5 per cent. sodium hydroxide, and iodine to stand 6 days in diffused light. The iodo-isatin may be prepared in two forms, red and yellow. The yellow may be changed to the red by heating alone, or with acids, or with organic solvents. Sublimation of the red form gives the yellow.

Mechanism of the oxidation of thymine. Thymine glycol: OSKAR BAUDISCH and DAVID DAVIDSON. In order to test the assumption that thymine glycol is an intermediate product in the oxidation of thymine, this glycol has been synthesized and some of its chemical properties studied. Thymine glycol in alkaline solution is quantitatively hydrolyzed to urea, acetol, and carbon dioxide. Thymine glycol upon oxidation and subsequent hydrolysis gives pyruvic acid. These reactions of thymine glycol are in agreement with the original hypotheses, since oxidation of thymine, followed by hydrolysis of the oxidation products, yields urea, acetol, and pyruvic acid.

Pyrimidine indigoids: DAVID DAVIDSON and OSKAR BAUDISCH. The oxidation of isobarbituric acid proceeds in two ways, giving isodialuric acid, and a new type of colored derivative. Apparently there is a strong analogy between isobarbituric acid and indoxyl by reason of the grouping $-NHCH_2CO-$. The formation of the new type of colored substance from isobarbituric acid is then analogous to the production of indigo from indoxyl. Consequently the name Pyrimidine Indigoids is suggested for this new class of substances. 5-Amino-uracil gives a similar oxidation product.

A synthesis of keto-tetrahydroquinoxaline and some of its derivatives: A. J. HILL and T. K. CLEVELAND. Keto-tetrahydroquinoxaline has been prepared by the reduction of either o-nitrophenylglycine or its ethyl ester, the amino compound undergoing immediate ring closure. 2,2′-Diethyl keto-tetrahydroquinoxaline is formed by the interaction of the ethyl ester of diethyl bromoacetic acid and o-phenylene diamine. The methylene group of keto-tetrahydroquinoxaline will condense with isatin, 5-bromo-isatin, 5,7-dibromo-isatin, and 5-iodo-isatin. The beta-isatin derivatives are yellow or light brown, and the

alpha analogues in each case of a *deeper* shade, but *not blue*, despite the close structural relationship to indigo.

The discovery of a new pyrimidine base in the nucleic acid of tubercle bacilli: ROBERT D. COGHILL and TREAT B. JOHNSON. Only three pyrimidines have hitherto been found among the nitrogen compounds formed by hydrolysis of animal and plant nucleic acids, namely: Uracil, Thymine, and Cytosine. We are now able to announce the occurrence of a fourth pyrimidine compound among the hydrolytic products of a bacterial nucleic acid, namely, 5-methylcytosine. This pyrimidine has been identified in the phosphotungstic acid fraction associated with cytosine after acid hydrolysis of tuberculinic acid, which we have separated from tubercle bacilli. This pyrimidine was synthesized by Wheeler and Johnson in 1904.

The constitution of diazo-imides and of aliphatic diazo compounds: HENRY GILMAN, C. E. ADAMS and H. H. PARKER. The products of reaction of diazo-imides (RN_3) and of aliphatic diazo compounds (R_2CN_2) with Grignard reagents can be interpreted most satisfactorily on the basis of straight chain structures. (Ber. 40, 2390, 1907: Monatsh. 34, 1631, 1913.) However, because of the possibility of a tautomeric hydrogen atom, the structures of the straight chain nitrogen compounds are uncertain. By the use of reliable reagents for "anchoring" the -MgX group in the intermediate compound it is shown that the Grignard reagent adds to the terminal nitrogen atom. Apparently diazo-imides and aliphatic diazo compounds can have the structures, $C_6H_5-N=N-N=$, $(C_6H_5)_2C=N-N=$. These formulas find confirmation in the results of unpublished work on the reaction of Grignard compounds with azo compounds, and with compounds having terminal cumulated unsaturated groups. Structures after the octet theory will be considered.

The structure of compounds containing unsaturation between nitrogen atoms: CHARLES D. HURD. Compounds containing two nitrogen atoms connected by a double or a triple bond reveal an unusual inertness at the point of apparent unsaturation. In contrast to the fact that a multiple linkage is usually regarded as a point of weakness, in this case it appears to be a point of strength. The reactions of such nitrogen compounds are considered under the following headings: Additive reactions, reduction, attempted syntheses of N-N linkages, hydrolyses, rearrangements, and thermal decompositions. G. N. Lewis has recently discussed the non-reactivity of molecular nitrogen and ascribes its stability to the following structure, :N:::N:. If we accept the assumption that a sextet of electrons provides a very stable configuration, it is possible to explain the inertness of multiply linked nitrogen compounds with similar electronic arrangements.

The Beckmann rearrangement involving optically active radicals: LAUDER W. JONES and EVERETT S. WALLIS. Acid azides and hydroxamic acid derivatives undergoing the Beckmann rearrangement are assumed, according to Stieglitz and Jones, to decompose giving isocyanates. Jones and Hurd have further shown that the relative ease of rearrangement seems to depend upon the tendency of the radical R in the intermediate univalent nitrogen derivative to exist as a free radical. d-Benzylmethylacethydroxamic acid and d-benzylmethylacetazide, compounds of the above type in which R is an optically active radical have been prepared. The azide has been studied in particular. By its rearrangement an optically active isocyanate was obtained, from which an active amine and an active monosubstituted urea were made. A discussion of these results is to be given.

Hydroxyethyl-hydroxylamines: L. W. JONES and G. R. BURNS. This paper deals with the preparation and properties of the compounds formed by the action of ethylene oxide on hydroxylamine and ethyl-hydroxylamine. o-Ethyl-hydroxylamine gives o-ethyl-N,N-dihydroxyethyl-hydroxylamine, and its dihydroxyethyl ether. O,N-Diethylhydroxylamine gives O,N-diethyl-N-hydroxyethyl-hydroxylamine. Free hydroxylamine gives N,N-dihydroxyethyl-hydroxylamine and trihydroxyethylamine oxide. These can be reduced to the corresponding amines. Trihydroxyethylamine oxide when heated with sodium hydroxide solution decomposes into dihydroxyethylamine. When heated with hydrochloric acid it decomposes largely into trihydroxyethylamine.

Natural occurrence of aconitic acid and its isomers: O. A. BEATH. Normal aconitic acid is reported as occurring in aconites, larkspurs, beet and cane sugar residues, and other plant sources. The free acid from diverse sources has been isolated and identified in our laboratories. In most cases the stable form has been found to be not the normal acid melting at 191°, but rather the labile type melting at 172–3°. Our work is the first establishing the occurrence of this form in plants.

The chemical composition of rosin: L. B. SEBRELL and D. N. SHAW. That abietic acid or other similar acids may be obtained from rosin has long been known. However, there is much conflicting data in the literature as to whether the free acid exists in rosin or whether its acidic nature is due to the presence of the acid anhydride. We have been able to show that rosin heated in carbon dioxide free of excess oxygen undergoes no change. However, the presence of a little oxygen in the carbon dioxide causes the formation of an oxyacid which readily loses water. Rosin, therefore, must consist essentially of free abietic acid.

A discussion of the work of the international committee on organic nomenclature: Led by AUSTIN M. PATTERSON, American member of the committee.

A new acidic substance isolated from the products of oxidation of 2,3,5,6-tetramethyl-d-glucose by alkaline hydrogen peroxide solution: W. LEE LEWIS and E. L. GUSTUS. Nef and his students have studied the products of oxidation of various sugars by means of Fehling's solution, air and hydrogen peroxide, and have advanced certain theoretical considerations to account for the formation of the various polyhydroxy acids obtained. A

study of the oxidation of the methylated sugars should give direct evidence on the correctness of these theories. Due to the stabilizing effect of methylation 2,3,5,6-tetramethyl glucose should give only a 1,2-ene-diol and the corresponding oxidation products. Oxidation by alkaline hydrogen peroxide at 45°, followed by acidification with hydrochloric acid and removal of volatile acids by vacuum distillations at 60–80°, gave a salty residue which was freed from organic matter by extraction with absolute ethyl alcohol. Vacuum evaporation of the alcoholic extract gave a gum from which crystals separated. This substance was purified and found to be 2,5-dimethyl-d-arabono-lactone, a new substance. The carbon dioxide and formic acid formed during the oxidation correspond to the theory for three carbons per mole of methylated glucose.

The action of alkalies on d-glucose: WM. L. EVANS and RACHEL H. EDGAR. The action of aqueous potassium hydroxide of known normality on d-glucose at 25° and 50° has been studied for the purpose of learning what relationship, if any, exists between the yield of lactic acid and the concentration of the base used. The results are briefly these: (a) The yield of lactic acid increases both with the concentration of the base and with the temperature; (b) the yield of formic acid reaches a maximum at 1.0 N base; (c) pyruvic aldehyde formation reaches a maximum at approximately 0.1 N base at 25°.

Tetramethyl-d-fructose, gamma form: W. LEE LEWIS, M. L. WOLFROM and R. D. GREENE. A study of the behavior of the methylated monosaccharides with dilute alkalies is being undertaken to throw light upon the Lobry de Bruyn reaction and saccharinic acid formation. Due to the well-known stabilizing effect of methylation, tetramethyl glucose should give no related methylated levulose in the Lobry de Bruyn reaction. Correspondingly, the methylated levulose should give neither the related methylated mannose nor glucose. Methylation of d-fructose in slightly acid solution gave the methylated gamma form of the sugar. Since this work was completed a note has been published by Haworth in which he indicates the same result. (*J. Chem. Soc.*, 125, 2468, Dec., 1924.)

Fluorescence and hydrogen-ion concentration: L. J. DESHA. Measurements of the relative intensities of the total fluorescent light emitted under illumination by ultra violet light from a quartz mercury lamp have been made with quinine, various naphthols, naphthylamines and sulfonic acids in concentrations of $M \times 10^{-3}$ to $M \times 10^{-4}$ in buffer solutions which had been checked by the hydrogen electrode. The curves of intensity of fluorescence against pH closely resemble the dissociation curves of indicators. The region of maximum change is usually confined to about 2 pH units. Neutral salt effects have been observed and the influence of different ions determined. The well known inhibition of halide ions on the fluorescence of quinine has been observed in other cases as well.

Gossypol: ALVIN S. WHEELER and E. D. JENNINGS. Although gossypol is said to be the substance which renders cotton seed meal poisonous, very little is known about it. Consequently an investigation of this substance has been undertaken. Cotton seed meal, nearly free from hulls, yields less than one per cent. of gossypol. It is a bright yellow substance which forms a red jelly at 180–190° and seems to form a compound with alcohol.

A qualitative color test for the Grignard reagent: HENRY GILMAN and F. SCHULZE. All Grignard reagents, so far tested, give a deep blue color when treated with a saturated benzene solution of Michler's ketone, then with a few drops of water, and finally with a 0.2 per cent. solution of iodine in glacial acetic acid. If metallic magnesium is present, the solution should be filtered prior to the addition of the iodine solution. Because the test is only given when the –MgX group is attached to carbon, it is of considerable value in showing when all the RMgX compound has been used up. The test is shown by the corresponding calcium and barium compounds and with sodium alkyls and aryls. With ethyl magnesium iodide a positive test is obtained when the concentration is as low as 0.076 molar. The mechanism of the reaction will be considered.

The active agent in aqueous bromination. (Lantern): A. W. FRANCIS. Bromination of organic compounds in aqueous solution has often been ascribed to the action of hypobromous acid on the organic compound. Evidence has been found, however, against this theory. Solutions of hypobromous acid always give grayish or dark brown bromination products with aniline and other amino compounds, evidently because of oxidation; while bromine water gives colorless products. Furthermore, bromination of m-nitrophenol is about 1,000 times as rapid with bromine water as with hypobromous acid, prepared from bromine water and silver sulfate. The active agent in both solutions is suggested to be nascent bromine. This is consistent with all the evidence offered for hypobromous acid as the active agent. It is also supported by the fact that gold leaf dissolves readily in bromine water, but is unattacked by hypobromous acid, and only slowly by non-aqueous solutions of bromine.

The partial bromination of some derivatives of aniline. (Lantern): A. W. FRANCIS. The addition of insufficient amounts of bromide-bromate solution to an acid solution of aniline precipitates tribromoaniline in amounts less than the amount of bromine added. These precipitates correspond to a smooth curve which is a function of the relative velocity constants of bromination. m-Amino compounds, which are likewise tribrominated, give exactly the same curve, showing that the other substituent affects the rate of bromination in each position to the same extent. o- and p-Amino compounds are only dibrominated and have two other curves, respectively, which are the same for members of each class.

Further studies of the absorption spectra of aliphatic ethers in the ultra-violet. (Lantern): ARTHUR J. YANEY, CECIL E. BOORD and ALPHEUS W. SMITH. The aliphatic ethers show absorption bands in the ultra-violet region very similar to those of benzene. Those ethers having a

normal chain of six carbon atoms have their absorption bands in identically the same position as the bands for benzene which they resemble in a remarkable way. As the molecular weight is increased the absorption pattern moves towards the longer wave length and the bands become more closely grouped. Branching of the chains seems to distort the absorption pattern so that the individual bands can no longer be distinguished. Ethers of the same molecular weight apparently have the same central frequency, but the symmetry of the absorption pattern varies directly with the symmetry of the molecule.

The relation of reaction velocity to rate of stirring in various systems: F. C. HUBER and E. EMMET REID. Three classes of reactions have been observed: (1) Those practically independent of the rate of stirring, (2) those in which the reaction rate changes with the stirring only above a certain speed and (3) those in which the reaction velocity is a linear function of the rate of stirring. In the first class are the saponification of ethyl benzoate and olive oil by sodium hydroxide, and the reaction of benzyl chloride with sodium carbonate or acetate. In the third class are the ethylation of benzene by ethylene and aluminum chloride, the condensation of carbon monoxide with toluene and aluminum and cuprous chloride, and the reduction of nitrobenzene by iron and acid, the solution of iron in acid, and the oxidation of sodium arsenite by gaseous oxygen. In the hydrogenation of cottonseed oil and of "solvenol" the relation is linear only above a certain speed.

N-Acyl derivatives of 3-Amino-4-hydroxy-phenylarsonic acid: GEORGE W. RAIZISS and BARRETT C. FISHER. This acid is important because of its close relation to arsphenamine. We have succeeded in forming a number of its acyl derivatives by means of the anhydrides of the lower members of the fatty acid group. A series of these new arsonic acids and their alkali salts have been obtained in chemically pure form as colorless crystalline substances.

A new method for preparing furane: W. COURTNEY WILSON. The preparation of furane from furoic acid (pyromucic acid) has been a difficult operation because carried out in sealed tubes. It has been possible to avoid this difficulty by merely heating the furoic acid at about 220° and removing the furane vapors at least six inches above the level of the acid. Yields of 65 per cent. are obtained. The method has been developed on a small plant scale.

The oxidation of indene by mercuric acetate: RALPH L. BROWN. Mercuric acetate either adds to olefines or oxidizes them to glycols. Indene reacts with mercuric acetate in dilute acetic acid at 25° to form a 25 per cent. yield of cis-hydrindene-1, 2-diol (m.p. 107–8°) and a slight amount of the trans isomer (m.p. 159–60°). The rest of the indene is converted into resinous material. About .9 mol of mercurous acetate is precipitated for each mol of indene used.

The discoloration of alcoholic potassium hydroxide: WM. F. WEBER. A 0.5 N solution of KOH in absolute alcohol turns yellow quicker than a similar solution in 95 per cent. alcohol. This coloration can not be prevented but can be delayed by preliminary removal of aldehydes and by storing in glass vessels in the presence of an inactive gas. Methods of treatment are discussed.

The preparation of ethyl crotonate: C. J. BROCKMAN. The reaction between alpha-bromobutyric ester and dimethylaniline has been studied. As high as 41 per cent. yields of ethyl crotonate have been obtained in this reaction.

Reduction of crotonaldehyde. (By title): HAROLD HIBBERT and C. P. BURT. Reduction of crotonaldehyde with various metallic couples gives mixtures of butyraldehyde, butyl alcohol, crotyl alcohol and dipropenyl glycol. The statement of Charon that no butyl alcohol is formed by means of the zinc-copper couple is incorrect, as the two alcohols, butyl and crotyl, are formed in approximately equal amounts. The relative proportions of the products varies markedly with the couple used. The largest yield of crotyl alcohol is obtained with Zn-Cu, while that of dipropenyl glycol reaches a maximum with Hg-Zn.

The electro reduction of acrolein: R. R. READ and R. M. FREER. One of the principal products of the electro reduction of crotonaldehyde is dimethyl cyclopentene aldehyde. That this is not an isolated instance is shown by the present research on the electro reduction of acrolein, the product being cyclopentene aldehyde. Divinyl glycol treated under similar conditions remains unchanged.

The relation between melting points and directive influence in the benzene ring. (By title): A. W. FRANCIS and JOHN JOHNSTON. In most of the limited number of cases for which data are available, the *meta* isomer has the *lowest* entropy of fusion when the two groups are *like* in directive influence, and the *highest* when they are *unlike.* In about 80 per cent. of the commoner systems, the *meta* isomer has the lowest melting point, when the groups are *like,* and the *ortho* isomer when the groups are *unlike.*

Hydrofluoric acid compounds of organic bases: J. F. T. BERLINER and RAYMOND M. HANN. Hydrofluorides of organic bases have not been studied. A series of hydrofluorides of aromatic aliphatic primary, secondary and tertiary amines, diamines, and amino acids have now been prepared and studied. In every case analyses show that four moles of HF combine with each $-NH_2$ group present. Wide variations in conditions fail to cause changes in the composition of these compounds. Most of them sublime unchanged. Some compounds, such as mono-methyl aniline, which do not usually give crystalline compounds with mineral acids, yield crystalline hydrofluorides.

Preparation and application of benzoyl hydroperoxide: HAROLD HIBBERT and C. P. BURT. The conditions for high yield and purity have been determined, and the conditions relating to its application to unsaturated compounds such as styrene, etc., have been ascertained.

The nitration of p-cymene: ALVIN S. WHEELER and C. R. HARRIS. Dinitrocymenes may be obtained by nitrating p-cymene or mono-nitrocymene. Purification is best accomplished by crystallization from a 5:1 mixture of

petrol ether and carbon tetrachloride, in which the chief by-product, 2, 4-dinitrotoluene, is less soluble. The dinitrocymene obtained is probably the 2, 6-isomer. This compound and its derivatives are being studied.

The mercuration of naphthoic acids. (Preliminary paper): A. L. FOX. Of the common methods for preparing alpha-naphthoic acid the most satisfactory has been found to be the fusion of the sulfonate with cyanide to form the nitrile which is then hydrolysed by a mixture of glacial acetic acid, water and sulfuric acid. The yield of pure acid calculated on the basis of sulfonate used is 25 per cent. The acid reacts unusually readily with mercuric acetate giving poly-mercurated products which are now being studied. A number of substituted naphthoic acids has been prepared. It is found that the ease of mercuration varies over wide limits. As in so many cases, ease of mercuration appears to run parallel to ease of bromination.

Further studies of chloroethers: F. E. CLARK, C. E. GARLAND, J. W. FARREN and H. R. FIFE. Further studies have been made of compounds of the types $R-O-CH_2Cl$ and $R'CO_2CH_2OR$. Methods of preparation have been improved and extended to include chloromethyl ethers of secondary as well as primary alcohols. The ethers and corresponding esters have been made from isopropyl and secondary butyl alcohol.

Condensation of the isomeric tolyl-2-thio-4-ketothiazalidines (rhodanic acids) with substituted vanillins: RAYMOND M. HANN. The condensation products of the three tolyl compounds with vanillin, 5-chloro-, 5-bromo-, 5-iodo- and 5-nitro-vanillin are yellow to deep brown dyes, but are not fast to light.

The condensation of rhodanic acids with isatin: RAYMOND M. HANN. Isatin has been condensed with phenyl-, o-, m- and p-tolyl-, "pseudocumidyl-," o-, m- and p-anisidyl-, 4-m and 2-p xylidyl- and alpha- and beta-naphthyl-rhodanic acids to give the corresponding 3-aryl-rhodanal-5, 3′-oxindoles.

Derivatives of arsanilic acid and amino-arsanilic acid. (Second paper): W. LEE LEWIS and P. L. CRAMER. Arsenated quinoxalines have been prepared from amino-arsanilic acid and glyoxal, lactosone and maltosone. Arsenated Schiff's bases have been prepared from glucose, mannose, galactose, laevulose, arabinose and xylose. The rotations are inverted by the introduction of the arsenated ring. The two arsonic acids have been condensed with a number of sulfone chlorides. Ethylene oxide and related compounds have been condensed with the two arsonic acids.

A method for measuring the separate ionization constants of poly-acids and -bases: O. E. MAY and S. F. ACREE. We have begun the actual measurement of H-ion concentrations of solutions of dibasic acids titrated with alkali varying from zero to more than two equivalents, at the same time measuring the free organic acid by partition with a solvent like CCl_4. With these data and values for the equivalent conductances of the acid anion equal to about one half those for the dibasic anion, we have calculated ionization constants for fifteen dibasic organic acids.

Quantitative studies of the mechanism of oxidation of phenolphthalin to phenolphthalein: RAYMOND M. HANN and S. F. ACREE. The electrometric titration curve for the two phenolic groups in phenolphthalin lies between pH 6 and 11. Only in this region is it found easy to study the oxidation by ferricyanides. The exact mechanism of the oxidation is being studied by means of electromotive force measurements and spectrophotometric data. Substituted phenolphthalins are also being studied to determine the effect of the substituent groups and of the change in the ionization constants of the phenolic groups on the reaction.

Spectrophotometric studies of the ionization constants, end points and fading of phthalein and sulfonphthalein indicators: K. S. MARKLEY, J. F. T. BERLINER and S. F. ACREE. At about pH 11 the end point of the titration curve for phenolphthalein is reached and the fading begins to be perceptible. A cell is described for the study of these phenomena at constant temperatures while spectrophotometric measurements are being made. The absorption curves for a number of indicators have been measured.

Sodium acid phthalate as an acidimetric and electrometric standard: N. E. KNIGHT and S. F. ACREE. Sodium acid phthalate is found to be a satisfactory standard. It is easily purified and obtained in stable form. It titrates sharply as an acid salt. A tenth molar solution has pH 3.96. The pH values determined at various dilutions give a value for K_2 for phthalic acid of 6×10^{-6} which checks with other determinations.

Elimination of contact potential between organic buffer solutions with potassium chloride and ammonium chloride: C. N. MURRAY and S. F. ACREE. Loomis and Acree found that 4.1 N potassium chloride nearly completely eliminates the contact potential between solutions containing HCl, KCl and organic buffers, in conformity with the theory of Planck that concentrated solutions with ions of equal mobilities should be most effective in this respect. We have studied the effectiveness of potassium chloride and ammonium chloride in solutions from 0.1 N upward. Nearly identical results are obtained. The use of rubidium bromide and potassium and ammonium perchlorates in this field will be investigated.

The use of organic buffers in colloid and H-ion studies in analytical chemistry: G. L. ROBERTS and S. F. ACREE. Buffer mixtures containing acetates, formates, phthalates, phenolsulfonates, borates and phosphates have been used to regulate the H-ion concentrations and the adsorbed ions in solutions of Al, Fe, Co, Ni, Cr, Mn and other metals in which the microscopic and cataphoresis studies of these colloidal precipitates have been made. Important analytical applications are indicated.

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